Hand Book

OF

Hygiene & Public Health

FOR

MEDICAL & PUBLIC HEALTH STUDENTS

By

YASH PAL BEDI,

M.B. B.S. (Pb.) D.O.M.S (Eng.) D.P.H. (London)

L.M. (Dublin)

SIXTH EDITION

Revised & Illustrated

1962

Dr. M. M. Joshi



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FOREWORD

It was with great pleasure that I have gone through the manuscripts of the Hand Book on Hygiene and Public Health sent to me by Dr. Yash Pal Bedi, Professor of Hygiene and Public Health, Amritsar Medical College. At present more attention is paid to the preventive aspect than before. Sir George Newman rightly observed, "It is not the event of death which we can escape but the incident of avoidable invalidity and premature death." That gives, in a nutshell the object of studying Hygiene.

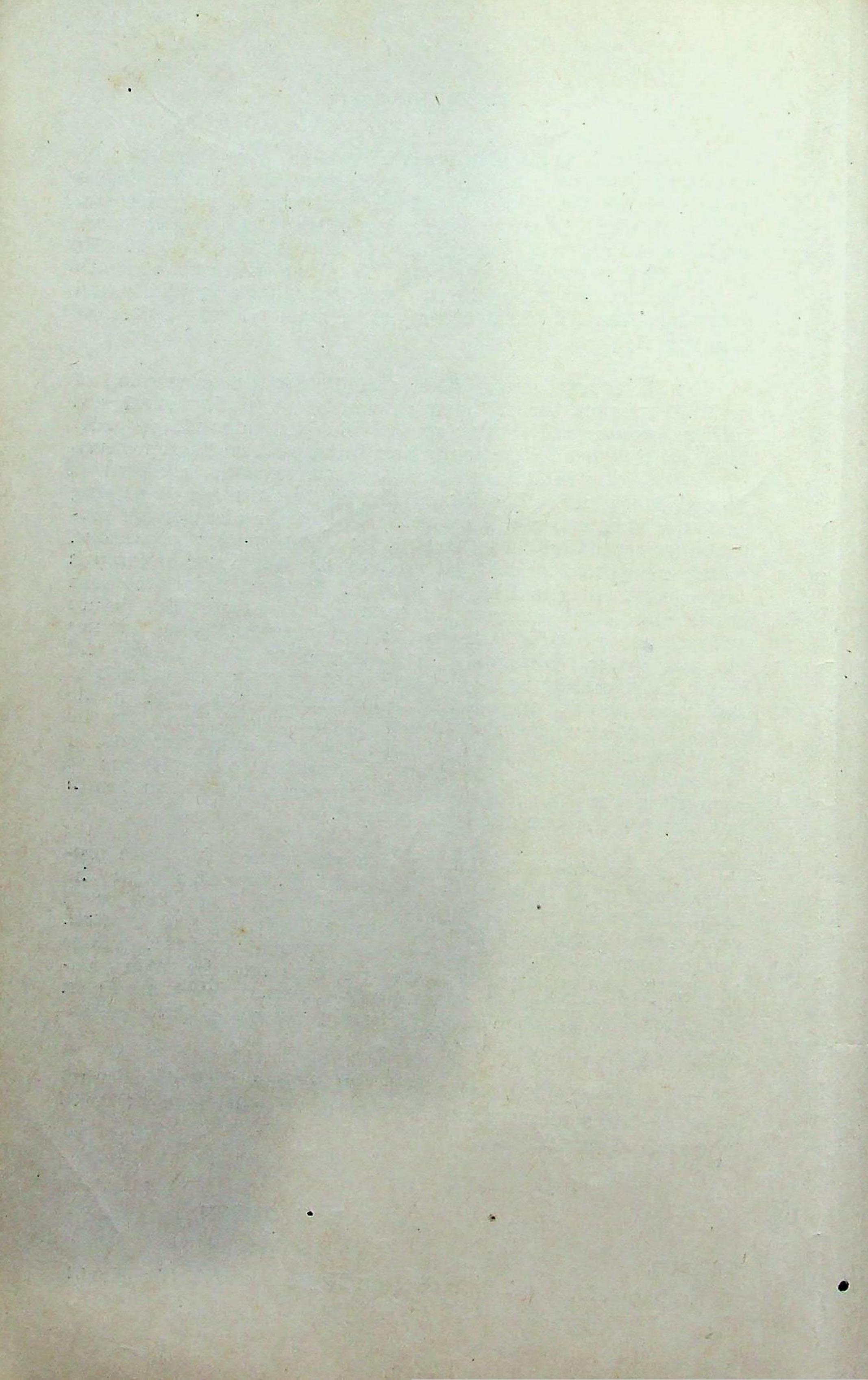
Health is not merely absence of disease, the conception of health envisages the full development of physical, mental and spiritual powers with which an individual is endowed. In order to attain this ideal, attention is now being paid in different countries, especially in England and America, to what is known as "Social Medicine". The World Health Organisation is playing an important part in this respect. Most of the diseases are preventable, specially those caused by some specific organisms, which are carried by different agencies like air, water or through some intermediaries like the insects. It has therefore been possible to adopt preventive measures according to the nature and method of spread of the different diseases. Since impure air and water, pollution of soil, bad disposal of refuse and excretal matter, errors in diet and want of proper cleanliness of the house and its surroundings play an important role in the spread of disease; these require to be carefully studied. On the other hand, the individual himself, being an important unit of the community, should be properly educated to enable him to appreciate the value of sanitation not only for his own health but also for the community in general.

It is essential that all these different factors should be properly dealt with in a book. And judging from this angle the hand book which Dr. Bedi has prepared will, I am sure be of great value inculcating the fundamental principles of hygiene. Apart from environmental hygiene, personal hygiene, village sanitation, sanitation of fairs and melas as also the main principles of prevention of communicable diseases so common in India, have been dealt with, succinctly, though nothing of importance has been left out.

I am sure that Dr. Bedi's book will meet with all the requirements of the students who I have no doubt will read it with interest and profit.

B. N. GHOSH,
Author of
Treatise on Hygiene and Public Health.

Calcutta,
December, 1954.



PREFACE

To The Sixth Edition

This edition is a complete revision of each chapter of the original book. New diagrams and many current references have been incorporated to bring it in line with today's scientific research and thought.

Broadly speaking the book covers the requirements of Medical and Public Health students as well as the students of Sanitary Inspectors' and Lady Health Visitors' classes. I have tried to use very simple language and terminology so that the book may prove beneficial to the average student.

I avail myself of the opportunity to thank my patrons both teachers & students alike for the appreciation and warm reception they have accorded to the previous editions. The author seeks in this revision to serve them even more adequately since no pain has been spared to make the book as complete and uptodate as possible.

My grateful thanks are due to Dr. Vidya Sagar M.B.B.S. Medical Superintendent, Punjab Mental Hospital Amritsar., Dr. Jagjeet Singh M.B.B.S. (Hons.) D.P.H. (Medalist). B.A. MedicalOfficer of Health Simla, and Dr. D. Anand M.B.B.S., M.P.H., Health Education Officer, (who are experts in their respective subjects) for writing chapters on Mental Health, Health Education and Vital Statistics respectively. I am grateful to Dr. K. C. Patnaik, M.B.B.S., D.P.H., Dr. P. H. (John Hopkin's) Associate Professor of Social and Preventive Medicine, All India Institute of Medical Sciences New Delhi for allowing me to utilize his lecture-notes on Public Health Administration and Social Medicine.

I am especially indebted to my friends and colleagues for rendering valuable advise and suggestions.

I am also indebted to the publishers and printers of the book for their co-operation and the general excellence of their production.

April, 1962.

Y. P. BEDI

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INTRODUCTION

Hygiene is derived from the Greek Hygeia, the goddess of health, who was supposed to look after the health of the people. It may be defined as the science and art of preserving and improving health. It is a science, in that it is based upon scientific knowledge ; and an art in that it involves the development of skill in the systematic application of the knowledge to the daily routine of life. It includes all such agencies as have a bearing on physical and mental health of man.

The aim of hygiene is not merely to impart knowledge but to teach the individual to take necessary action to improve the quality of his life in its physical as well as mental aspects, so that he may have buoyant health throughout life.

Hygiene deals both with the individual and the community. The branch of hygiene that concerns itself with the adjustments which the individual must make to preserve and improve the health of his body and mind, is known as Personal Hygiene.

The art and science of maintaining, protecting and improving the health of the people through organised community efforts is known as Public Health. It is concerned with the control of communicable diseases in the protection of the community and with furnishing medical service to special groups of persons.

Sanitation is the branch of public health that is concerned with keeping the external environment healthful. The word sanitation is derived from the Latin word Sanitas which means a state of health. Environmental Sanitation means the control of all those things, in man's surroundings which cause or may cause, a bad effect on his body's development, his health and his length of life. The sanitarian directs his efforts towards the maintenance of a safe drinking water free from pollution and harmful organisms, controls the disposal of sewage, conducts inspection of sanitary conditions of food supply, enforces housing regulations and supervises the control of rats, flies, mosquitoes and other intermediate sources of disease transmissson.

Social Hygiene deals with the problems of sex, from the health point of view, and refers to the measures adopted for the control of venereal diseases.

Preventive Medicine is defined as the science and art of preventing disease, prolonging life and promoting physical and mental health and efficiency. The objectives of Preventive Medicine are to promote a positive-state of health, to prevent departure

from it and to prevent disabling illness after disease agents have gained access to man.

Health:—According to the old English term health was a condition of being "*hal*" that is safe and sound. Webster Collegiate Dictionary defines heath as "the state of being hale and sound in body, mind or soul especially from physical disease or pain." It is a state of relative equilibrium of body form and function which results from its successful dynamic adjustment to forces tending to disturb it. It is also defined as the state in which the mental and physical activities of the body are adjusted satisfactorily to the environment. To be in health means much more than freedom from diseases and discomfort. It includes normal functioning of all parts of human organism resulting in physical strength and vigour, mental stability and satisfaction with life.

J. F. Williams defines it as the quality of life that enables the individual to live most and to serve best. This definition suggests that health is capable of enrichment or deterioration, that health at its best is a more realistic concept for all reasons than the mere avoidance of disease, and that the proper goal of all health teaching is the finest kind of individual living.

According to World Health Organisation, health is defined as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity."

Health implies a sufficient reserve of physical strength, agility and endurance, as well as mental poise to meet the demands of every day life. The healthy individual is characterised by:—

1. Sense of wellbeing.
2. Ability to work efficiently and with enthusiasm.
3. Cheerfulness.
4. Self-confidence.
5. Self-control.
6. Absence of disease and physical discomfort.
7. A wholesome mental attitude.
8. Freedom from unnecessary anxiety.
9. Courage to face reality, and ability to act with others in harmonious groups.
10. Wholesome fatigue at the end of day with restful undisturbed sleep at night.

There are various levels or degrees of health; like success and wealth, it is always relative and must be thought of in terms of the age of the individual. Perfect health is an abstraction, by no means an attainable condition Optimum Health is the highest level of health attainable by the individual. The attainment of optimum health is an objective for which each individual should strive.

Each individual's health is in a large measure, his own responsibility. Life does not owe us health any more than it owes us success. Health is not an inalienable right nor does it come to us as a matter of chance. It is a goal to be achieved. Life can be of great significance, if the necessary effort is put forth to attain a high level of physical and mental well-being. Wise attention and conformance to nature's code ef health offers a good reward, whereas neglect of her requirements takes the toll not only in wrecked bodies but also in diseased minds.

Factors that influence health :—The health of an individual depends partly on his inheritance and chiefly on understanding of those factors that influence health and the proper use of knowledge gained through such understanding. The individual who covets a full, rich and wholesome life, must include in his programme of living an adequate amount of :—

(*a*) Wholesome food
(*b*) Physical activity, outdoor play, adopted to his individual capacity, interest and needs.
(*c*) Good body carriage.
(*d*) Proper care of feet.
(*e*) Preventive and therapeutic, dental and medical services whenever needed.
(*f*) Ample sleep each night under healthful eonditions.
(*g*) A suitable occupation.
(*h*) Proper use of leisure time.
(*i*) Wholesome mental attitude towards life.

Apart from these, there is no magic prescription, nor any secret formula that can promise health. Good health is out of reach, if one turns a deaf ear to cardinal requirements of nature.

Adjustment to Environment :—In order to exist, living organisms must adjust themselves to particular locations in which they dwell, that is to their environment. The process of living involves constant adjustment and readjustment to environmental factors. Man, as well as other living beings, is inseparably dependant upon and thoroughly interwoven with environment.

The environment of modern man is partly natural and partly man-made, and consists of physical, biologic and social factors. It is the source of his food, fuel, shelter, clothing and all the things he uses.

Among the *physical factors* are climate, air, light, sunshine, temperature, food, water, buildings and their contents and the numerous mechanical devices, which modern man has learned to produce.

The *biologic factors* consist of the animals and plants including disease producing microorganisms, in his surroundings.

The *social factors* include customs, beliefs, ideas, peculiarities and ways of living of human-being with whom he comes into contact.

The *medical factors* consist of services needed by every one, e.g. control of insect pests, control of communicable diseases and the existence of maternity and child welfare services, school, medical services, hospitals etc. Because man is a social organism, his adaptation to the complex social and economic order, characteristic of modern civilisation is as necessary as adaptation to his non-social surroundings. Since few environment factors are static, life is a continuous process of adjustment and readjustment to an ever changing environment. The complexity of the environment of modern man places a strain on his powers of adjustment and calls for intelligence and effort to make proper adaptations. The present unsettled condition of the world adds to these problems.

Education in general increases the individual's capacity to live his life understandingly, i.e. to make proper adjustments to his total environment; health education enables him to make the necessary adjustments to attain the highest level of health for which he is biologically capable.

To attain buoyant health, the individual must learn to cope successfully, with his physical, biological and social environments. If he is successful in this achievement, he has acquired the art of living healthfully. Adjustment is the price of life.

Positive Health :—It is clear that health connotes dynamic or positive conception as opposed to the negative one.

"Positive Health" has been suggested to bring home to the individual that through his own initiative "something" can be generated and developed in his body which will give him the maximum utility of body and mind. The criterion of a healthy human being is his joy of life. The body may show no sign of disease and environment may be favourable, but unless there is also a "will to live" achievements will be few. We must stimulate the will to be healthy. Without "self help" to live healthy, it is impossible for anyone to draw the best of life.

Real wealth of a country does not consist in its mineral wealth and other natural resources but in its happy men and women. A sick man is a liability while healthy man is an asset to the country. In this connection one is reminded of the famous lines of Goldsmith, "Ill fares the land to hastening ills a prey, where wealth accumulates and men decay."

In the promotion of positive health the medical profession have a vital role to play. They have to change their concept of medical practice which begins and ends with the care of sick patient. They have to be physicians for the healthy. They

must catch the disease before it shows itself. Periodical medical check up, examination of school children, life insurance examinations are health measures for detecting any deviation from health and have helped to hammer home the importance of getting medical advice before one is obviously sick.

In caring for the sick, the physician has not only to treat the disease but the total man. For if they are to handle patients it is necessary to bring clinical judgement to bear not only on the patient but also on the circumstances under which his illness arose. He will have to think his patient as human being with day to day social problems.

It is evident the health in the prevailing concept is more than the prevention of disease or the correction of defects. It is of utmost importance that the positive side of health be developed. Thus life will be made fuller, richer and happier. In this noble task of building a healthy nation, the physician's role, in propagating the message of health, is a vital one. It is hoped that the medical profession will not be found wanting to take up the leadership in the crusade for health.

In order to fulfil the concept of positive health or health at optimum level, medicine has to take into consideration, all the contingencies of man during his life cycle beginning in the womb of the mother till his death, not as an individual but as a member of the family and a member of the society.

Previously, health promotion of the individual of the family was considered to be a man's own business. The view now has changed and every child born is a potential community asset and hence should be conserved, protected and developed. Medicine has to function in a wide sphere for the physical, mental and social wellbeing of the community.

————

CHAPTER I

WATER

Without water there would be no life. For this reason in early times habitation used to be near rivers, lakes and springs.

Water constitutes nearly two thirds of the total weight of the body, *i.e.* 79% of blood, 80% of brain and muscles and 10% even of bones.

It is required both for internal and external cleanliness of the body. Usually it is utilised as a solvent and diluent in the body. Its main functions are :– that it.

(*a*) Replaces loss of fluids from tissues.
(*b*) Maintains the fluidity of blood and lymph.
(*c*) Helps elimination of waste materials of the body.
(*d*) Acts as a vehicle for dissolved food.
(*e*) Helps in the secretion of digestive juices.
(*f*) Regulates body temperature and acts as a distributor of body heat.

Quantity of Water Required by Man :—The minimum amount of water requird for an ordinary town, with water carriage system and industries requiring water, is 30 gallons per head of population per day for all purposes. It has been estimated as follows :—

(*a*)	Drinking and cooking	1 gallon
(*b*)	Washing clothes, utensils and houses, ablution and bathing	11 gallons
(*c*)	Water closets	5 gallons
(*d*)	Trade and Industry	5 gallons
(*e*)	Municipal-streetwatering, public baths, flushing sewers and extinguishing fires ...	5 gallons
(*f*)	Animal drinking and cleansing of stables	3 gallons

In hospitals 40-50 gallons of water per head must be supplied daily. The amount required daily for domestic use varies greatly and depends upon the habits and standard of living of people, existence of water carriage system and the presence of domestic animals.

On an average, a horse requires about 15 gallons and a cow 12 gallons of water per day with a little variation, depending upon the prevailing season and the size of the animal.

Quantity of water supplied per head per day in different towns is as follows :—

1.	Simla ...	... ...	15 gallons per head
2.	Calcutta	... ...	60 „ „ „

3. Lahore	... ...	30 gallons per head
4. London	... ...	35 ,, ,, ,,
5. Edinburg	... ...	50 ,, ,, ,,
6. New York	... ...	100-150 ,, ,, ,,
7. Tokyo ...	... ...	48 ,, ,, ,,

Sources of Water :—As a matter of fact all water is primarily derived from ocean. In tropical regions, evaporation of water into air is so great that it has been estimated that about 700 gallons of water are evaporated every minute from each square mile of ocean surface.

Water reaches earth in the form of rain, hail, snow, dew or mist, from water vapours in the atmosphere, derived mainly from evaporation of the sea, from lakes, rivers and other waters of the land. Sea water contains sodium chloride and land waters contain a lot of dissolved and suspended impurities, but they evaporate in the form of pure distilled water which reaches earth again in the form of rain, snow or hail. This condensed water from the air is pure except for a few impurities that are absorbed from the atmosphere.

Fate of the Rain Water :—On reaching the surface of the earth :

(*a*) Part of rain water is evaporated, depending upon the temperature of the air. The higher the temperature the greater is the evaporation.

(*b*) A portion of it runs away at once in the direction of the natural fall of the ground and gets collected in small streams which form rivers, and finally it runs into the sea.

(*c*) Part of it percolates into the earth and serves as underground water and is made available to the surface of the earth in the form of wells or springs.

(*d*) A portion of it, due to the configuration of the earth. collects on the surface in the form of ponds, lakes etc. and from such collections evaporation takes place.

Hails rapidly melt and act as rain. Snow may, however, lie for sometime before it melts. One point of sanitary importance is that infective materials may lie for a long time without being destroyed in snow and when it melts infection may be carried to drinking water.

Sources of Water Supply

The chief sources of water supply are :—

1. Rain water or snow water and artificial lakes.
2. Surface water i.e. streams, canals, rivers, tanks and ponds.

3. Upland surface water and lakes.
4. Ground water i.e. wells and springs.
5. Sea Water.

1. RAIN WATER

All the world over man derives his water supply from rainfall. In some places in India, it is used as a source of water supply, where rainfall is heavy and water of springs and wells is brackish. This source is not depended upon except where more satisfactory supplies are not available, as for instance in Malta and Gibraltor.

A good example of this system is seen in operation at Lawrence school, Sanawar, near Kasauli hills in India. The Rain water is collected there from roofs and impervious surfaces, made of cement and stored in reservoirs in such a quantity as may not run short of it, even during the periods of draught.

Rain water, although pure to start with, receives impurities from the atmosphere such as dust, soot, suspended matter and even microbes, gases like hydrogen sulphide, carbon dioxide, ammonia, nitrogen, oxygen, etc. The first rain which falls on roofs and other impervious materials will be contaminated with dirt, including birds' droppings, eggs of insects, dust, etc. over the roofs and other collecting surfaces.

Whenever it is to be used for drinking purposes, arrangements should be made to exclude from the water storage tank or the reservoir, the first portion of the rain that falls. For this purpose any mechanical arrangement such as "Roberts" or "Gibbs" rain water separator may be fixed to the rain water pipe. It allows the first portion of the rain water to run waste.

To prevent contamination of the stored rain water, the reservoir should be such as can be cleaned easily and protected from surface pollution; for leaves, animal excreta or other impurities might find access into it. A tap or a pump must be provided for drawing the water from it and on no account the public is to be allowad to dip their own receptacles which may be contaminated and become the means of introduction of disease germs. If the reservoir or tank is to be made underground it should be built either of sound masonry brick work or cement.

Rain water, if properly collected and stored, is a good water. It is soft, as it contains no (or very little) mineral salts dissolved in it. The advantage is that it is suitable for cooking, washing and bathing purposes. However, its one serious drawback is that being soft, it is liable to corrode lead pipes and thereby cause lead poisoning. In tropics, *aedes* (*stegomyia*) *aegypti* breeds in artificial cisterns holding rain water.

A rainfall of 1" in depth corresponds to about 4·67 gallons on one sq. yd. or 22,617 gallons (101 tons) on each acre of land. The amount of water that can be collected from a roof in a year is calculated as follows :—The area of the roof in sq. feet × half the amount of rainfall in inches=gallons of water per year.

2. SURFACE WATER

Rain water on reaching the grourd or the melted snow from hills begins to flow and is seen as a river, canal, stream, lake or a pond and is called Surface Water. These are waters which drain from the surface. The great advantage of these sources of water is that they can supply a very large amount of water. The disadvantages are that they represent rain long time after it has fallen, and has travelled a very long distance. The river water is fairly pure and unpolluted at its source but during its course it becomes more or less polluted as most rivers and streams serve as the natural sewer of the region they drain. Consequently, they contain suspended materials, which are harmful mechanically. As a matter of principle river water is softer than ground water but contains sufficiently large amount of organic matter in it. All rivers are very muddy and contain much suspended matter. Some of the tributaries of the Indus contain minute particles of mica in suspension, which causes irritation of the bowels. They may contain harmful metals dissolved in them, as for example the rivers of Wazirstan contain magnesium sulphate, which if taken causes irritation of bowels. Rivers, streams and canals being open water courses, are freely used by the people for washing, bathing and so forth. They get polluted by human and animal excreta either accidently or purposely. Trade effluents are also discharged from the factories. Dead bodies are burnt on the banks of rivers. These are other sources of pollution.

The running water in rivers, canals and streams is naturally purified to a certain extent due to sunlight, by deposition due to sedimentation and by dilution. The shallow and small rivers which dry up in summers are dangerous from the sanitary point of view.

The proper remedy is to prevent wilful pollution of rivers, streams and canals. For this purpose an act called 'River Pollution Preventive Act' is enforced in England. A similar act should be enacted in India also.

To minimise the risk of excretal contamination of a river for water supply, the water should be taken from a point of the river, above and not below the spot, where sewage and other impurities are discharged into the river. Of course, there is certain pollution even higher up, but in the course of its flow it undergoes self purification by sedimentation of the solid matter, and by oxygenation of the organic matter on account of oxygen present in the water. The sun, too, has a purifying action due to

its actinic rays and the amount of such purification depends upon depth, magnitude and the rate of flow of the river. The ultra violet rays of the sun however cannot penetrate water when it is turbid.

Another precaution to be observed is, that water should be taken from the river at least 20-30 ft. away from the bank, where the contamination is comparatively less. This object can be achieved by using a pipe attached to a hand-pump.

The yield of water of a river can be estimated by finding out its width over a known distance and its average depth. The product of both these (factors) gives the sectional area. The mean velocity is 4/5 of the surface velocity. The yield of the river is the product of velocity and the sectional area.

It can also be found out by rivulet method. In this case water is allowed to pass through a channel of known dimensions. The yield of the river is the product of velocity and depth.

The water from the river, canal or the stream is collected in large reservoirs or settling tanks. These should be protected from contamination. The capacity of these storage reservoirs should be such as to hold a week's water supply. Subsequently the water is filtered to get rid of bacteria and suspended impurities.

It may be further sterilised by chlorination or by other methods to bring the water to a very high standard of purity.

Tanks or Ponds :—These are a good source of water supply, in some villages in India, if kept free from pollution. In these tanks water undergoes natural purification.

In an ideal tank or a pond the following points should be attended to :—

1. The soil for excavation should be a good soil having good surroundings. Avoid madesoil and loose sandy soil having filthy ponds and cesspits. There should be no insanitary or borehole latrines in the vicinity.

2. It should be properly fenced. Trees should be planted at a distance to keep away the cattle and dirt.

3. It should be fairly deep and large and preferably of a rectangular shape having an area of about an acre. Banks should be properly sloped and covered with grass. The surrounding area, should have a low embankment to prevent any other water getting access into the tank, except the rain water.

4. All bathing and washing should be strictly forbidden. Moreover, steps and ghats should not be provided in the tank.

5. Arrangement should be made for drawing water from a platform by means of a hand-pump.

6. Weeds and algae should be removed regularly. Whenever water in the tank or pond deteriorates, it should be emptied out and re-excavated, as growth of algae makes the water unpleasant to taste.

7. Jute steeping should not be allowed in the tanks.

3. UPLAND SURFACE WATER

This is the water, which runs on the sides of hills, slopes and valleys and is taken off as watersupply, before such water collects to form big streams and rivers. Water may be collected in the form of natural lakes as in the city of Glasgow or in artificially constructed lakes as has been done in the cities like Bombay, Madras and Darjiling. The area from which this water is collected is called the "Catchment area." The water supplied to Simla is an example of this kind of water supply. At a short distance from Simla proper, there is a ridge of low hills, called the Mahasu ridge, which drains into a deep "Nala". between the ridge and Simla. The rain water flows along the slope of the ridge, which is well wooded and constitutes the catchment area. The water thus collected is called the upland surface water.

An upland surface water is good because it is pure rain water, which has travelled a short distance over the earth. The dangers are:—

(*a*) Excreta of humanbeing in catchment area may find its way into the water, and infect it with pathogenic microorganisms. As such the catchment area should be strictly reserved and only those should be allowed to enter it, whose business is to look after the water arrangements. In spite of strictest precautions there still remains a possibility of contamination.

(*b*) Excreta of animals may pollute the water supply; therefore grazing of cattle and herds of animals in the catchment area should be prohibited.

(*c*) Freshly collected water may corrode lead. It forms an easily soluble hydrate of lead, which remains on the inner surface of lead pipes, cisterns, etc. and on becoming detached, enters water. If the water is acidic in reaction, the lead is actually dissolved and when consumed will give rise to lead poisoning.

(*d*) In some catchment areas the ground contains peat which is a decayed vegetable substance and is commonly used as fuel. It contains acids such as humic and ulmic, which make the reaction of water acidic. It also imparts brownish or yellowish colour to the water. As for example, there are deposits of peat in the catchment area in Sheffield. In 1887, as a result of prolonged draught, the water in the Sheffield reservoir ran very low. The peaty acids derived from the catchment area were not diluted, so the reaction of the water became very much acidic and it gave rise to epidemic of diarrhoea. It dissolved lead in that water and caused a severe leadpoisoning epidemic.

The upland surface water needs purification by filtration and sterilisation by chlorination.

Yield of the catchment area can be found by E. Pole's formula :—Q=62.15 A (4/5 R—E).

Q=gallons per day
Where A=area in acres
R=average rainfall for three driest consecutive years
E=loss of inches in evaporation

Lakes :—They are simply natural collections of upland surface water in a valley with a high ground at its outlets, which checks all water escaping at once, e.g. Lock Katrine Lake which is utilised for the water supply in Glasgow. When collected from unpopulated hilly districts, such water, being usually soft and contains but little chlorine, affords an excellent supply. It does not contain ammonia, nitrates and nitrites more than the proportion in which they are usually found in rain water. It however contains more dissolved matter than rain water. Water collected from lowland surfaces usually contains much peaty matter as well as phosphates and nitrates, washed from manures of cultivated flelds. This is why it becomes yellow or brownish in appearance. The lake water requires filtration before drinking.

4. GROUND WATER

Wells :—These are artificial holes or pits dug into the earth to reach the underground water level. They constitute a very important source of water supply in Indian villages. There are four varieties of wells:—(a) *Shallow Wells* are those which do not penetrate an impermeable stratum. They simply tap the ground water lying between the surface and first impermeable stratum. The water of these wells gets polluted, either from surface water or from contamination of subsoil water.

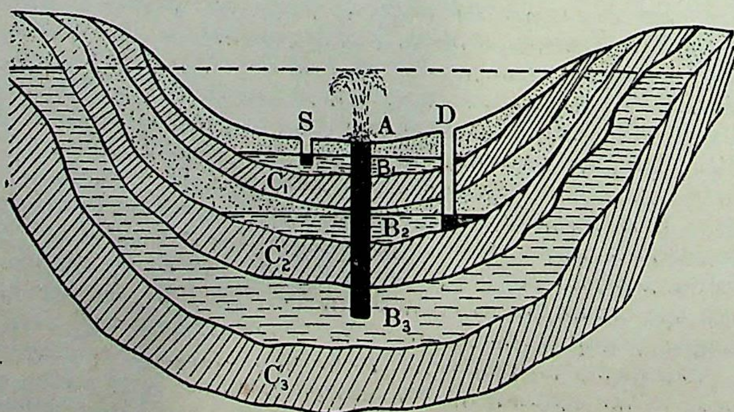


Fig. 1—Different varieties of wells

S—Shallow well D—Deep well A—Artesian well

$B_1B_2B_3$—Water bearing Strata $C_1C_2C_3$—Impermeable Strata.

(b) *Deep Wells* are those which tap some water bearing layer below the first impermeable stratum. They may pass through one or more impermeable layers. They yield comparatively safer water for drinking than shallow wells because their water travels a greater distance through the earth and also gets better protection from surface contamination by the impermeable strata above. Of course a crack in the stratum may allow surface contamination to reach the deep water directly. They yield, as a rule, more permanent supplies than shallow wells. The water is usually pure and germfree, but is often hard.

(c) *Artesian Wells* are a variety of deep wells in which water under great pressure comes to the surface automatically. To accomplish this, the strata, which the well penetrates, must be cup shaped and the upper level of the ground water tapped between the two impervious strata must be higher than the surface of the earth where the well lies. Thus in such a case the water shoots up. They are named after Artois province in France where they have been in use from a very long time.

(d) *Norton's Abyssinian Tube Wells* are really shallow wells which are formed by simply driving iron pipes 1½" to 2" in diameter and 20-25 ft. deep to tap the ground water. A pump is attached to the pipe to draw the water. Chiefly they were used temporarily in the Abyssinian Campaign. These are used where the ground water is not many feet deep below the surface. When not required the iron pipes may be removed and used for the same purpose in another place. These wells are of use only when a temporary water supply is required. Since water is drawn out by means of pumps, their water is free from most of the dangers manifested in open wells.

Cone of Filtration of a Well :—This is an area drained by a well and it regarded as an inverted cone, the apex of which is represented by the bottom of the well.The area drained is about four times the depth of the well.

Dangers to Shallow Wells :—Practically all village wells are shallow ones. Consequently any filth on the superficial permeable layer of the earth is liable to percolate through it, unless special measures are taken to prevent it. This is likely to happen, if the direction of the flow of ground water is from the filth towards the well. Therefore in cases of shallow wells, the position should be such that the ground water flows in a direction to and not from the possible sources of pollution, such as human habitation, and particularly gross sources of pollution e.g. leaking cesspools or trenches used for the disposal of excreta. Making of trenches or disposal of excreta in other ways should be prohibited within a definite distance of a well, say 200 ft. or if the ground is very porous it should be at least 300 ft. This principle

should also apply to other possible sources of pollution such as latrines, manure heaps, collection of refuse and burial grounds.

Requirements of an Ideal Well :—1. It should be tapped in a good soil and should be at least 200 ft. away from any possible source of contamination like leaking cesspool, insanitary privy etc.

2. The site should be sufficiently high to prevent entrance of water from outside into the well.

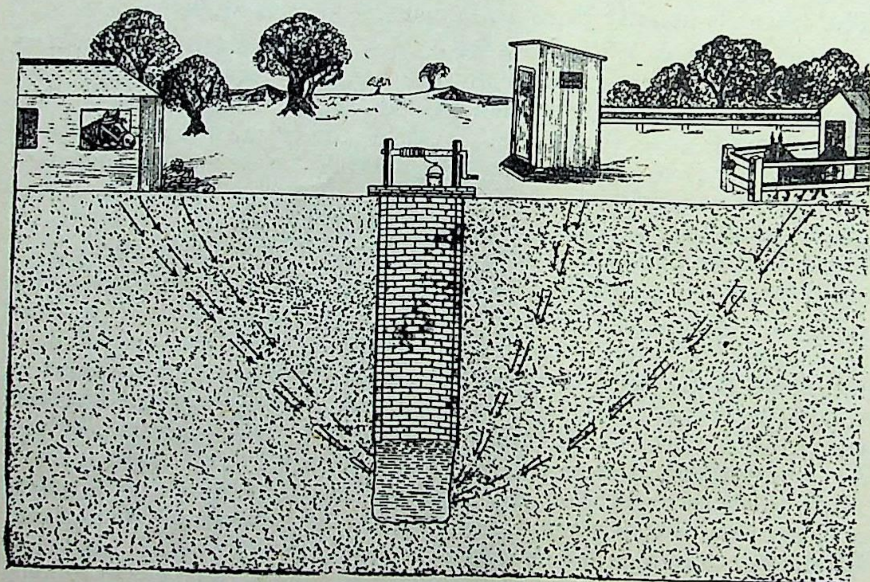


Fig. 2—How well gets infected from surface pollution.

3. It should be a deep well *i.e.* sunk below the first impermeable stratum.

4. It should be properly steined *i.e.* built with bricks and lined with cement or a water tight casing of concrete, bricks set

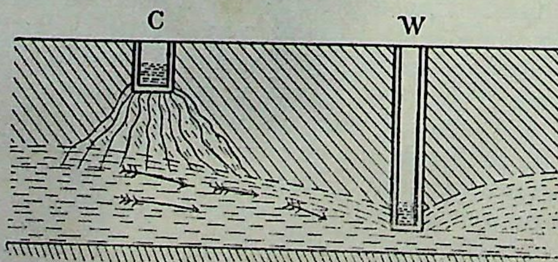


Fig. 3—Contamination of well from cesspool as a result of excessive pumping.
C—cesspool: W—well.

in cement or having a metal wall, reaching below the water level, below which the joints are open to admit the water to the well. The water should only come from the bottom. The surface water cannot get into the well, unless it has travelled a great vertical distance which ensures filtration.

5. Roots of trees should not be allowed to sprout from the linings of the wall.

6. The space between the wellwall and the lining should be sealed by cementgrouting.

7. It should be properly covered to prevent leaves, and dust from blowing into it and also to prevent sparrows and pigeons making their nests in the crevices of the wall.

8. Around the top af the well, a parapet wall 2½ ft. high should be provided, so as to prevent the surfacewater entering the well. The top of this wall should be sloping and not horizontal to discourage people sitting on it or washing clothes thereupon and thus contaminating the well water.

9. There should be a cemented area at least 6 feet, with a fall away from the well, so that the surface washing may run away from it and not into it.

10. It is best that no washing of clothes, utensils and bathing of persons be allowed near a well, as it is not uncommon in Punjab for a well to be infected by washing clothes, *etc.* of patients suffering from cholera and other diseases. The best way to avoid this practice, is to provide a proper washing and bathing place at a distance from the well to which water can be pumped by means of channels.

11. All hollows, foultanks. cesspits etc. near the well should be filled up and useless trees and vegetation cut down.

12. The public should not be allowed to lower their own buckets or receptacles into the well for drawing up water, for there is a danger of their carrying pathogenic microorganisms which might infect the well water. It is best to have a handpump or any other mechanical contrivance for drawing up the water, which should be discharged by a pipe ending at some distance from the well, so that no water after possible contamination, can run back to the well. In the absence of any provision of such a mechanical contrivance it is desirable that a bucket and a chain for public use should be attached to the well permanently.

Qualities of Wellwater :—To all intents and purposes it is an excellent water. The bacterial count is very low. It is cool and generally sparkling due to the dissolved carbon dioxide of the ground air.

Cleansing of Well :—This is done at the close of the hot weather, when the water is at the lowest level. The well must be dewatered. Scrape the sides and remove all mud, silt, stones

or pieces of bricks which block the pores at the bottom of the well. Then treat the well with lime or bleaching powder solution.

Examination of Wells :—The following points should be noted while examining a well:—

(*a*) Size and depth of the well.
(*b*) Depth of water in the well.
(*c*) Nature of the soil in which the well is sunk.
(*d*) Any possible sources of pollution within 200 to 350 ft. of the well.
(*e*) Average quantity of water which is daily drawn out.
(*f*) The way in which waste water is disposed off.
(*g*) Mechanical contrivance with which water is drawn e.g. pump, rope and bucket.

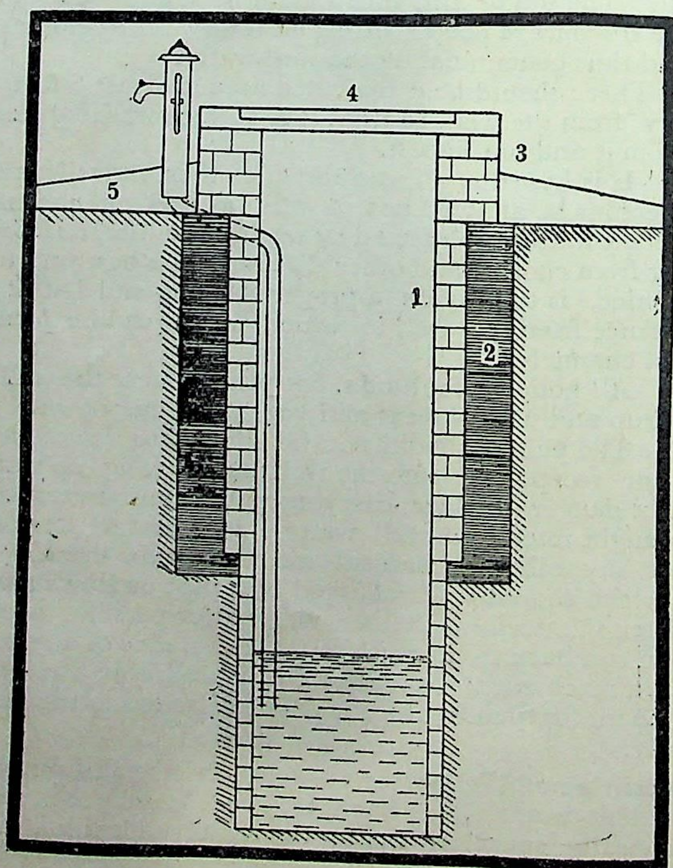


Fig. 4—A properly protected well :
1. Cemented brick work 2. Puddled clay 3. Platform
4. Cover 5. Channelled drain.

Detection of the Sources of Pollution of a Well :—If a source of contamination is suspected in the neighbourhood of a well, it is detected by pouring certain chemicals which may be recognized on account of their characteristic smell, taste, colour and other chemical and physical properties into all the pools, drains, etc. which may be regarded as possible sources of pollution. The following methods of examination may be adopted:—

1. By adding strong solution of sodium chloride and detecting the increase of chlorides in well water.

2. By adding alkaline solution of fluorescein (1 lb. of fluorescein and 1 lb. of caustic soda to 10 gallons of water) and detecting the fluorescein in well water by means of fluoroscope.

3. Suspension of bacillus prodigiosus may be added and later on red colonies grown and ultimately isolated from the water.

4. Kerosene oil may be poured and its smell and tinge detected in well water.

Yield of a Well :—At first lower the level of the well water by pumping and notice the rise of water in it at intervals of 15—30 minutes.

The quantity of water in a well can be measured by the depth of water in feet × square of the diameter of the well in feet × 5 = gallons of water.

Deep Tube Wells :—These are largely used for municipal watersupply and also for irrigation purposes. The average yield of a deep tube well of 1 to 1½″ diameter is 200-300 gallons and of 9″ diameter is 60,000 gallons of water per hour. The yield mainly depends upon the water bearing strata and a little on the diameter and depth of the tube.

These are sunk through hard surfaces by boring through rocks with special machines. The depth is between 300-400 ft. and the characteristics of water are like deep well waters. In many towns, the water supply is now obtained from these tube wells.

The water obtained is free from bacteria. It does not, show faecal bacilli in 60 c.c. The water is hard due to presence of calcium carbonate, sodium chloride in variable quantity, traces of iron, etc. The greater the depth from which the water is obtained, the more likely higher is the percentage of its mineral contents.

Critical Velocity :—The water flows through the filtering medium of sand outside the strainer of a tube well, without disturbing the sand bed. But if the rate of pumping is rapid or excessive, the water carries sandgrains with it and the velocity at which this disturbance starts is called "Critical Velocity".

Cone of Influence :—With the drawing of water the level in the well falls, resulting in a tendency of the water to flow into it from the surrounding area. The area within which the level is appreciably lowered is called the "Circle or Cone of Influence".

Springs :—These are natural outlets of ground water which is under pressure, due to the approach of the first impermeable stratum to the surface. These can therefore be considered as natural wells out cropping at places where the geological conditions are favourable

Varieties of Springs. They are :—1. *Surface Springs or Shallow Springs or Land Springs* :—These are outlets of limited collection of ground water resting on the superficial impervious strata. They are of intermittent nature, supplying water when the level of the subsoil water is high, as during rains, and ceasing to flow in summer season and starting again in autumn on the commencement of percolation. They are unsatisfactory as a source of watersupply. They are open to the same objections and liable to be manifested with the same dangers as the shallow wells.

2. *Deep or Main Springs* :—These derive their watersupply from extensive water bearing strata. The water of these springs is clear, sparkling and is generally safer, having been filtered in its passage through the earth, and the flow is also constant. The water is often hard. These springs have no surface outlets but issue through a fissure or a crack in the soil.

Springs may prove to be a good source of watersupply for small communities and at places where conditions are favourable. As for example, the watersupply of Darjiling town is derived from springs throughout the dry weather.

Ordinarily, spring water is pure and less liable to contamination, there being no mechanical means to draw out the water. It is generally cool and palatable, but is highly charged with carbonic acid gas, which it absorbs from the ground. Moreover, on account of passing under pressure, it dissolves out lime and various other salts contained in the soil through which it passes. Consequently it gets hard and becomes unsuitable for washing and cooking purposes, although it may be valuable from the medicinal point of view.

3. *Hot or Thermal Springs* :—These result from continuance of high internal temperature after a volcanic eruption has ceased. They continue to maintain their heat even for centuries. These springs may arise in places even hundreds of miles away from the volcanic vent. As examples may be mentioned springs of Sitakoond, (in Chittagong), Rajgir (in Bihar), Vajreswari (50 miles from Bombay) in India and springs of Bath and Buxton in England.

4. *Mineral Springs* :—The water of mineral springs is highly charged with mineral salts and so used for medicinal or therapeutic purposes. There are also Sulphur Springs which contain sulphuretted hydrogen and various sulphides in solution. Waters containing iron or magnesium in solution are known as Chalybeate or Magnesia water.

Yield of a Spring :—This can be determined by :—1. Finding out the time, which it takes to fill a vessel of known capacity. The output of water in one hour can thus be determined.

2. By leading the entire flow of a spring over a V or a rectangular notch and measuring the depth of flow over the site of the notch. The yield of the spring can be calculated from charts and different formulae.

Safeguards against Pollution of Springs :—The sources of pollution, such as leaking cesspits, insanitary privies or latrines, stables etc, should not be situated near the springs. The springs should be protected by a masonary structure, to protect surface contamination. The hydraulic ram is a useful apparatus for lifting small quantities of water from a flowing source such as stream or a spring.

5. SEA WATER

Distilled sea water is used for drinking purposes, on board the ships and in places like Aden where wells happen to be brackish and the rain does not fall even for several years. Distilled water is flat to taste as all gases are driven from it by boiling and it is consequently unpalatable. So aeration of the water should be done by allowing it to trickle down through a long column of wood charcoal, if it is required for drinking purposes. As it acts on lead, copper, zinc, and iron, none should be exposed to its action in condensing apparatus. Silver and tin linings are the best for the pipes and the vessels used in the distillation apparatus.

PURIFICATION OF WATER

Impure water may be purified by either of the following methods :—

A. Natural
- (1) Pounding or Storage.
- (2) Oxidation and Settlement.

B. Artificial
- I. Physical.
  - (*a*) Distillation.
  - (*b*) Boiling.
- II. Chemical.
  - (*a*) Precipitation.
  - (*b*) Disinfection or Sterilisation.
- III. Filtration.
  - (*a*) Slow sand filtration.

(*b*) Rapid mechanical filtration.
(*c*) Domestic filtration.

Filtration of Water Supply on a large scale :—Water is got rid of the suspended matters, the ova, cysts, spores and bacteria by the use of filters which are of the following two types :—

(*a*) Slow Sand Filters.
(*b*) Rapid Mechanical Filters.

Slow Sand Filtration :—This system was first introduced in England about more than a century back and it is therefore often

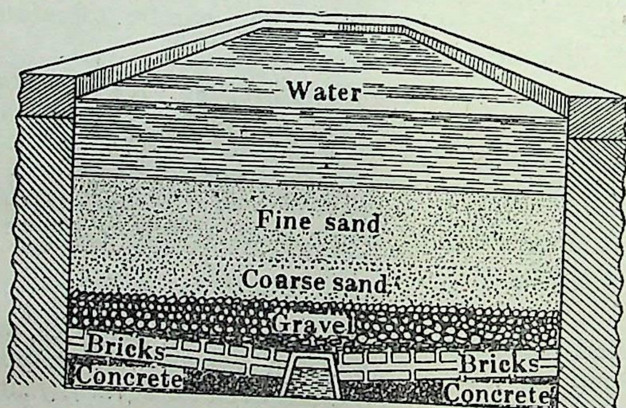


Fig. 5—Section of slow sand filter

termed as English System. The raw water from the source, usually a river, canal or a stream is collected and stored in large open reservoirs known as *Settling Tanks* and is allowed to remain there for a period of 24 to 48 hours. The solid matters in suspension gravitate to the bottom. The colour of water is discharged and its bacterial count is reduced. Storage of water for a period of about 3-4 weeks renders the watersupply pretty safe prior to filtration. This process of sedimentation can be hastened by adding a coagulant such as alum or sulphate of ammonia which is specially done in rainy season, when the water becomes turbid, in specially constructed circular mixing troughs, before its entrance to the settling tanks. This process of sedimentation has a great influence on bacterial life; their number is generally reduced by 90%.

The water is now allowed to circulate slowly from a higher level and then to gravitate from above into the filterbeds downwards.

Filterbeds are water tight rectangular masonary tank or reservoirs, usually arranged side by side and ordinarily kept

open. These are usually about 9-12 feet deep. They are filled up from below upwards as follows :—

1. There are two layers of bricks placed one above the other on their edges, which are arranged in the form of drains and channels for the passage of filtered water. Over the bricks, layers of the following materials are arranged systematically one after the other.

2. 6″ to 12″ gravel, broken stones or pebbles (size 1½″ cubes)
3. Coarse sand 6″ to 12″.
4. Fine sand 36″.
5. Water from settling tanks 36″.

Thickness of these materials varies at different places, but an important thing is that the thickness of sand layer is never less than one foot. To ensure uniform filtration, these filter beds are provided with valves at outlets and inlets.

The size of the filter depends upon :—

1. The size of the community to be supplied with water.
2. The quantity of water per head to be supplied.

The action of slow sand filter is threefold:—1. *Mechanical Obstruction or Physical* :—The suspended impurities are strained off by the upper portion of the filter.

2. *Chemical* :—The organic matter in the water is oxidised by the presence of air and the nitrifying micro-organisms in the sand.

3. *Real Biological Action is carried on in the Vital Layer.*— After the filter bed has been working for 2-3 days, a thin green slimy gelatinous layer of algae and fungi etc., called the vital layer forms on the surface of the superficial layer of sand. This layer retains all the bacteria of the water so it should not be disturbed. Denser the film becomes in course of time, slower becomes the rate of filtration and greater becomes the pressure head; necessary to ensure delivery of the requisite amount of water. So after some time, when this layer gets thick, a few inches (usually ½″ to 1″) of sand at the top is scraped off, removed, washed and replaced usually at an interval of 6-8 weeks. But when after repeated cleansing, the fine layer of sand gets reduced to 16-18 inches, it becomes necessary to restore and renew the bed. This is usually done after an interval of 3 years.

For efficient filtration of water through these filters, the rate of flow should not exceed 4 vertical inches per hour. The rate of flow may be increased if the filtered water is subsequently to be treated with chlorine or its compounds. The type of sand used has an important bearing on the proccss of filtration. It must be fine but it should be neither too fine nor too coarse.

The new filter takes about 3 days' time to work. As it takes about 3 days to form vital layer on the surface, so the water

issuing from the filter is allowed to run waste until the bacteriological examination of water shows that the efficient filtration is taking place.

As it is necessary for the filter to be out of use at intervals, the water works must have at least two, or even more filter beds so that one is always available for use. In Calcutta water supply at Palta Water Works, there are 4 filter beds with a capacity of one million gallons and 8 filter beds with a capacity of 3 million gallons each.

Water should be tested for bacteriological examination by drawing a sample of water every week, to see that the filters are working properly *i.e,* arresting the passage of bacteria efficiently. An adequately filtered water should not contain more than 1-2 bacillus coli per 100 cc.

Rapid Mechanical Filters :—They are less expensive, simple and easy in manipulation and require a very small area of space. They are small and fixed inside a covered shed. They consist of large wooden, iron or concrete cylinders about 7 feet deep containing a filtering media consisting of quartz or sand, 4 to 5 feet in thickness, supported on broken pieces of stones or pebbles.

They are capable of filtering water at a very high rate *i.e.,* 100-130 gallons per sq. feet per 24 hours or 150 inches or more per hour.

They may be either of pressure or gravity type. In pressure filters, the chamber is closed and the coagulated water is driven through the sand under its own head of pressure. Whereas in gravity filters, the water is passed through a coagulating basin to open filter through which it gravitates. In this process of rapid filtration the following steps are involved :—

1. Coagulation and formation of "floc".
2. Filtration.

In this system, the place of the vital layer of slow sand filter is taken by a filtering layer artificially made by producing a flocculent precipitate, which with colloidal silt settles on the surface of the sand and fills up the sand interspaces.

There are many varieties of rapid mechanical filters. The important one is Paterson's Rapid Filter.

The raw water is pumped into settling tanks where heavier material or silt is deposited and certain amount of natural purification takes place.

There are 4 distinct processes involved in the Paterson Gravity system of rapid filtration which are as follows :

1. *Coagulation* :—The water from settling tanks is led continuously into the plant, after passing through the measuring

gear. Then a coagulant, usually aluminium sulphate in proportion of 1-4 grs. to a gallon, is added. It flows down the trough, where it gets thoroughly mixed up with the chemical by means of baffle plates. There a flocculent white gelatinous precipitate of aluminium hydrate is formed.

2. *Sedimentation* :—Water enters into another tank where most of the suspended and colloidal matters are precipitated. As the flocculent precipitate settles down, it carries with it other suspended matters and bacteria which may be present in water. It also affects decoloration. Here water is allowed to remain for 3-6 hours, which varies depending more or less upon the prevailng season and the quality of water required.

3 *Filtration* :—Water is then admitted into a series of rapid filters. The coagulant present in the water helps to form a gelatinous layer on the surface of the sand through which water is forced.

4. *Chlorination* :—From the filters it passes through an automatic regulating gear into a chlorinating chamber, where chlorine gas is added and water is sterilised.

Cleansing of the Filters :—Owing to high rate of filtration the filtering medium becomes loaded with micro-silt., organic matter and bacteria, which interferes with the efficiency of the filters So these filters require frequent cleansing; the frequency varies according to the quality of water and the season of the year. Cleansing of the filter is done by shutting the inlet valve and passing a reverse current of filtered water from the clean reservoir through the bottom of the sandbed and simultaneously stirring up the sand by means of rotatory metal arms, rakes or a blast of compressed air. The wash water flows away to the waste over the top. A thorough cleansing of filter takes place within 15-20 minutes and a satisfactory film is formed in another 20 minutes and the filter becomes ready for service again.

The bacterial purification is not, however, so constant and uniformly high as that of the slow sand filter.

Filtration Head :—The rate of filtration through slow sand filter is controlled in such a way, that the flow is maintained at a steady rate of 4 vertical inches per hour. The filtered water from the filter bed is led into filter well and if the water in the well is allowed to run out; it is found that half an inch of the lower level of water in the well causes sufficient flow of water at the desired rate through the filter. This half an inch difference in the level is known as *Filtration Head or Working Head.*

Loss of Head :—It is the frictional resistance offered to the passage of water through the filter beds by the vital layer formed on its surface and its interstices, so that after sometime

half an inch difference of the working head becomes insufficient to draw water at the standard rate through the sand. The remedy is to increase the working or filtration head by lowering the sill until even a difference of level of about 18″ to 24″ is reached.

Comparative Study of Slow Sand and Rapid Mechanical Filtration :—

	Slow Sand Filter	Rapid Mechanical Filter
1.	This is an old and English Method.	This is more recent and an American Method.
2.	A large piece of land is required.	Very little space is required.
3.	Initial cost is high for installation.	Initial cost is less but running expenses are more.
4.	Suitable for clear or slightly turbid waters.	Suitable for turbid waters.
5.	Provision of settling tanks is a necessity.	Provision of settling tanks is not necessary.
6.	No coagulant is necessary.	Coagulant such as aluminium sulphate is necessary.
7.	Water is filtered slowly through the filter bed.	Water is filtered rapidly.
8.	The action in the filter is physical, chemical and biological.	Working process is mainly mechanical.
9.	Delivery rate is slow *i.e.*, 2½ to 4 million gallons per acre per day.	Delivery rate is rapid *i.e.*, 100-200 million gallons per acre per hour.
10.	Cleaned by scraping off superficial layer of sand, washing and replacing it after drying. The renewal and resetting of filter is required after 3 years.	Cleaned very quickly by mechanical agitation of sand bed by compressed air and by a reverse current of filtered water. No renewal or resetting is required.
11.	There is a danger of contamination from labourers.	There is no such danger.
12.	Algae growth hampers the action.	Algae does dot grow.
13.	Results are good and uniform so chlorination of water is not a necessity.	Results are not so good and uniform so there is the necessity of sterilising water with chlorine.

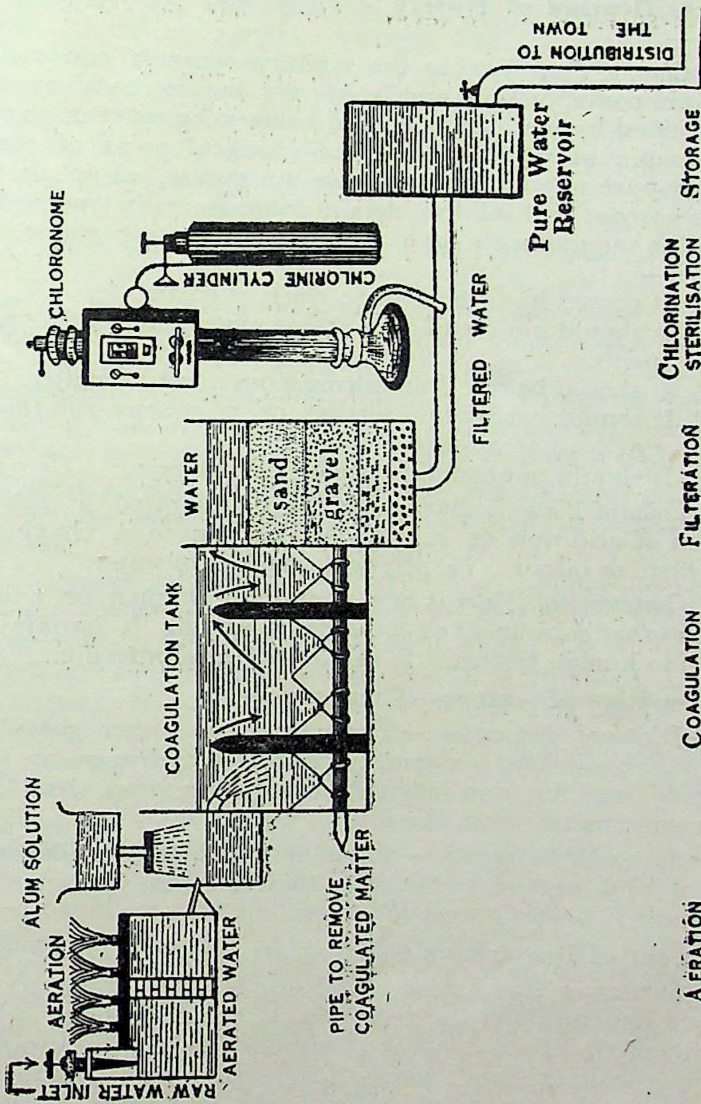


Fig. 6—A complete system of water supply

IMPURITIES OF WATER

Classification of Waters :—These may be classified as follows :—

1. *Clean or Pure Water* in the sanitary sense is one which is free from contamination and is safe for human consumption, as determined by the chemical and bacteriological examination of the sample of water. From the chemical point of view, absolutely pure water is not available in nature, as it always contains gaseous and solid matters in solution or in suspended form. The requirements for a wholesome drinking water are as under :—

   (i) It should be without taste, smell or colour.
   (ii) It should not contain an undue amount of solid constituents.
   (iii) It should be free from nitrogenous organic matter.
   (iv) It should not contain nitrites, or poisonous substances *e.g.*, lead or arsenic.
   (v) It should not contain pathogenic bacteria.

2. *Polluted Water* is that which has deteriorated in quality by reason of addition of substances, leading to a change in colour, taste or odour. *i.e.* physical qualities of water.

3. *Contaminated Water* is one containing human or animal wastes or other substances or poisons rendering it harmful or injurious to human system. It carries potential infection.

Impurities of water :—These are :—

(a) *Dissolved Impurities* :—These may be either gases like excess of carbonic acid, oxygen, sulphuretted hydrogen or salts as chlorides, calcium and magnesium sulphate, iron, lead and other organic matter from the soil.

(b) *Suspended Impurities* :—These may be inorganic like sand, silt, mud and organic which are derived from vegetable and animal matter, bacteria, ova of worms, etc.

Sources of Impurities :—These are classified as follows:—

(a) *Substances Received at the Source* :—The character of water will depend upon the geological structure through which it has travelled. Thus chalk wells produce hard water from the presence of calcium and water from near the graveyards contains organic impurities. Water obtained from wells in towns or densely populated places often contains calcium, sodium, nitrites, nitrates, sulphates, phosphates, etc. Water in the wells or tanks may become contaminated by surface washing or through percolation of offensive materials.

(b) *Impurities Derived during Transit from Source to the Reservoir* :—Rivers, canals, etc. are liable to be polluted by sewage, house and waste water, manufacturing refuse etc.

(c) *Impurities during Storage* :—However carefully the water may be stored, it often deteriorates, loses its sparkling character and becomes insipid and flat. In this country water is stored in *gharras* or metal vessels, wooden tubs or masonary tanks (*choubachas*). When stored in metal vessels and kept covered, although it partly loses its aerated character, it remains pure. *Gharrahs*, *surrahies* or other earthen vessels have the advantage of keeping the water cool and sparkling, but being porous they take up dirt and may contaminate it. These vessels are liable to accidental contamination.

(d) *Impurities in Distribution* :—Certain waters have the property of dissolving lead and other metals. In cases where the supply is intermittent and the pipes are left empty, sewage and impure air may be drawn into the empty pipes through leaky joints and cracks. It is therefore necessary to lay the water mains at a distance from gas pipes. Where water is distributed by *bhishties*, who use leather bags or *mushaks* which are not possible to keep clean ; such water cannot remain pure.

Classification of Impurities of Water :— Impurities of water may be inorganic or organic. They may be in suspension or solution.

1. *Inorganic Impurities in Suspension* :—These consist of more or less minute particles of sand, chalk, clay or other insoluble minerals which are mixed with water, the drinking of which leads to mechanical irritation of the intestines and sets up diarrhoea. Such muddy water may be cleared by simple sedimentation in storage tanks. To accelerate such sedimentation on a large scale, alum (6 grains to a gallon) is added to water. It forms a precipitate of aluminium hydrate, which is gelatinous and while sinking to the bottom carries down the suspended matter along with it. Alum is also used in the U.S.A. for the formation of filtering film on the surface of sand in rapid mechanical filters. Such a film is supposed to be strong enough to allow a much more rapid rate of filtration than ordinary slow sand filtration and the water, in fact, is forced through the filter under pressure so that in a given time the filter can deal with as much as 50 times the quantity of water that could be filtered by ordinary method. But it is doubtful, whether this rapid mechanical filter is as efficient as the ordinary slow sand filter.

2. *Inorganic Impurities in Solution* :—They include salts causing hardness of water and other salts of metals such as lead, iron, zinc, etc.

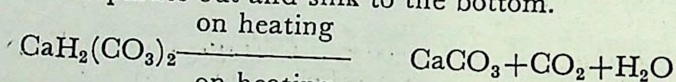
Hardness of water is caused by certain salts held in solution. The most common are the carbonates, chlorides and sulphates of calcium and magnesium.

Types of Hardness :—It is of two kinds :—

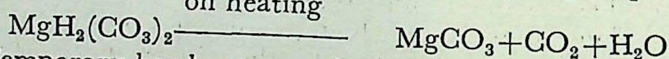
1. *Temporary Hardness* :—This can be got rid of by boiling the water.

2. *Permanent Hardness* :—It persists even after boiling.

Temporary Hardness :—Temporary hardness is chiefly due to the presence of calcium carbonate (chalk) or magnesium carbonate in water held in solution by carbon dioxide. They exist in solution as bicarbonates and as carbonates, they are insoluble in water. On boiling, carbon-dioxide escapes and insoluble carbonates separate out and sink to the bottom.

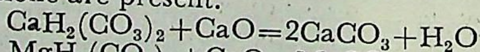


$$CaH_2(CO_3)_2 \xrightarrow{\text{on heating}} CaCO_3+CO_2+H_2O$$

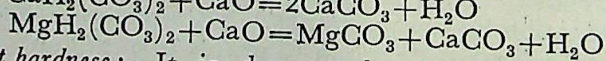


$$MgH_2(CO_3)_2 \xrightarrow{\text{on heating}} MgCO_3+CO_2+H_2O$$

Temporary hardness can also be got rid of by adding lime *i.e.*, calcium oxide to water, which precipitates bicarbonates of calcium and magnesium. This is a principle of Clark's process sometimes used on a very large scale as boiling of water on large scale is expensive. One ounce of calcium oxide per 1000 gallons of water for each Clark's degree of hardness (each degree of hardness corresponds to 1 gr. of calcium carbonate in 1 gallon of water) is required for this purpose. This is allowed to stand for 12 hours. If an excess of lime has been added, the water will form a dark yellow colour when treated with a few drops of silver nitrate solution and a white precipitate will be formed if chlorides alone are present.



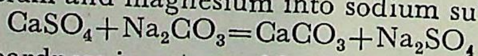
$$CaH_2(CO_3)_2+CaO=2CaCO_3+H_2O$$



$$MgH_2(CO_3)_2+CaO=MgCO_3+CaCO_3+H_2O$$

Permanent hardness :—It is due to the presence of chlorides and sulphates of calcium and magnesium.

It is removed by the addition of lime and soda either in the form of hydrate or carbonate which converts some of the sulphate of calcium and magnesium into sodium sulphate, thus :



$$CaSO_4+Na_2CO_3=CaCO_3+Na_2SO_4$$

The total hardness is estimated by finding the amount of a standard soap solution which will neutralise the hardness and produce a lather. The water is then boiled, when the temporary hardness is removed and the amount of soap solution necessary is again found. This second figure is due to permanent hardness and by subtraction the temporary hardness can be estimated.

Amount of total hardness minus amount of temporary hardness is equal to amount of permanent hardness due to the presence of sulphates of calcium and magnesium.

In the case of water containing considerable amount of permanent as well as temporary hardness, a mixture of both

calcium hydroxide and sodium carbonate is often used to remove hardness of water.

Degrees of Hardness and their effects :—The amount of hardness of water is generally expressed in degrees. According to Clark, each degree of hardness corresponds to the soap destroying power of 1 gr. of calcium carbonate in one gallon of water. According to hardness different waters are classified as under :—

Less than 10	degrees	hardness	=soft or moderately soft.
10-15	,,	,,	=moderately hard.
15-30	,,	,,	=hard.
Over 30	,,	,,	=very hard.

It has been estimated that water containing 15 degrees of hardness will involve a loss of about 22 lb. of soap per 1000 gallons of water. Hard waters upto 25 degrees are not harmful for drinking purposes and somewhat hard waters are more palatable than very soft ones. But a very hard water supply has the following disadvantages :—

1. It wastes soap.
2. It is unsuitable for cooking vegetables and meat and for making infusion of tea and coffee.
3. Temporary hard water causes a deposit of calcium carbonate on inside of boilers and kettles forming a coat, which interferes with the smooth action of the boilers and may cause explosion.

The advantage of a hard water supply is that calcium carbonate and magnesium carbonate will neutralise any acid present in it and hence will not dissolve lead or other metals as the soft water may.

Softening of water on a large scale :—The processes are :—

(*i*) *Clark's process* :—It consists of (1) addition of the necessary amount of lime usually as 10% milk of lime—done frequently by a mechanical regulator (2) thorough mixing (3) sedimentation (4) drawing of the clarified and softened upper layer.

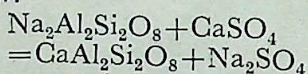
(*ii*) *Porter-clark's process* :—As Clark's process is comparatively slow so the suspended particles of chalk are removed by filtering through coarse linen cloth under pressure. This method has therefore the advantage of rapidity and removal of suspended matter effectively.

(*iii*) *Housten's excess lime method* :—It is good for bacterial purification of hard water. The water is over-dosed with quick lime. The excess of lime is removed by the addition of unlimed water or by passage of carbon dioxide. This process is cheap and reliable. It also softens water.

(*iv*) *Stanhope System* :—In case of water containing considerable permanent as well as temporary hardness, a mixture of both

lime (CaO) and caustic soda (NaOH) is sometimes employed (Lime Soda Process).

(*v*) *Base exchange* :—The softening of permanent hard water can be done on a large scale or for domestic purposes by filtering the water through a Permutit Media. Natural zeolite is called green sand or gluconite. (Permutit is synthetic zeolite containing sodium and aluminium silicate) when the calcium and magnesium present in the hard water are replaced by sodium which passes off in the outflow.



$$Na_2Al_2Si_2O_8 + CaSO_4 = CaAl_2Si_2O_8 + Na_2SO_4$$

The permutit water softner consists of a closed cylindrical tank ; its upper part contains a chamber where salt solution is automatically prepared for regeneration purposes. Its lower portion contains a bed of permutit.

The efficiency of the permutit gradually lessens, so it is necessary, to regenerate its sodium base by passing through the medium a strong solution of common salt. By mass action sodium displaces calcium and magnesium and the life of the filter is completely renewed.

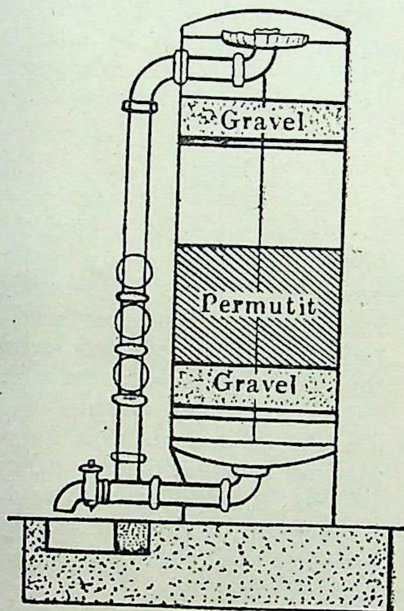
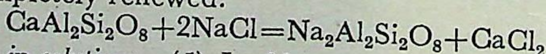


Fig. 7—Permutit Water Softner



$$CaAl_2Si_2O_8 + 2NaCl = Na_2Al_2Si_2O_8 + CaCl_2$$

Metals in solution :—(*1*) *Lead* is most important. The following kinds of water act on lead :—

(*a*) Soft water by virtue of the dissolved oxygen forms oxyhydrate of lead which is dissolved more rapidly by acidulated water. Peaty waters are acidic in character and so dissolve lead from lead pipes. They have more plumbo-solvency than mineral acids.

(*b*) Waters containing nitrates or nitrites in solution or an excess of carbon dioxide.

(*c*) Upland surface waters containing humic and ulmic acid.

(*d*) Distilled water and muddy river water.

The following kinds of water do not act on lead :—

(*a*) Hard water containing lime and magnesia.

(*b*) Water containing silica.

Plumbism :—It results from the prolonged use of water containing lead. Taking of water containing lead in the propor-

tion of 0.09 parts of lead in 100,000 parts of water has proved fatal. Water should not contain more than 1/20th grain of lead per gallon. The chief symptoms of lead poisoning produced from taking repeated doses of lead are :—Anaemia, constipation, colic, wrist-drop and other manifestations of peripheral neuritis as well as depression, renal disease and finally death.

(2) *Iron contained* in the strata of earth may find its way into the water supply. It may be derived from rusting of the inner coating of pipes when iron pipes are used. It gives rise to dyspepsia and constipation. The presence of not more than 0.01 part of iron per 100,000 parts of water is to be allowed in drinking water.

(3) *Zinc* may be found in water in small quantities. It gives rise to obstinate constipation. Such water should be condemned. Zinc is however, rarely present in water in a proportion considered to be dangerous.

(4) *Fluorine* may be found in deep well water when bored in bauxite or other phosphatic strata. The water causes dental dystrophy, with mottling of the enamel of the teeth in children.

3. *Organic impurities* are derived from animal and vegetable kingdom. These are important from the point of view of health because they include the impurities derived from contamination of water by excreta and urine which may contain disease germs capable of living and multiplying in water and communicating the diseases to the people, who happen to drink that water. These are called water-borne diseases *e.g.* cholera, dysentery, enteric fever, including typhoid and various paratyphoids A and B and epidemic diarrhoea.

Poliomyelitis (infantile paralysis) is sometimes considered to be due to taking water contaminated with faeces by the agency of flies.

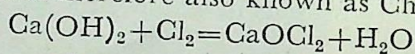
Entozoal diseases due to distoma hepaticum, ascaris lumbricoides, etc. may be contracted by drinking water containing eggs, larvae, etc. of these parasites. Bilharziasis and guinea worm infection occurs due to infected water.

McCarrison's view is that goitre is due to the presence in water of a microorganism, which produces toxin in the intestines of a man which acts on the thyroid gland and enlarges it, but others consider it due to lack of iodine in water or food. In infants the condition of cretenism characterised by stunting of body growth, mental backwardness etc., is caused by iodine deficiency. It has therefore become a common practice now-a-days to incorporate minute quantities of iodine in the water supply of such an area or in common salt.

Detection of actual disease germs present in water supplies after these have been enormously diluted with water and other

bacteria, is difficult. In practice one must be satisfied usually with the evidence that the water has been contaminated with excreta and if this is found, one must condemn the water for drinking purposes. Such evidence may be obtained by chemical and bacteriological examination of water.

Sterilisation of Water on a Large Scale:—This is affected on a large scale by the following methods :—1. *Chlorination* :—It is most efficient, cheap, reliable and easily supplied method. It destroys pathogenic micro-organisms but does not remove its turbidity. So the raw water is first filtered and then chlorinated. Chlorine is used in the following forms for the sterilisation of water :—(*a*) *Bleaching Powder or Chlorinated Lime* :—It is prepared on a large scale by passing chlorine gas over slaked lime. It is therefore also known as Chlorinated Lime.



$$Ca(OH)_2+Cl_2=CaOCl_2+H_2O$$

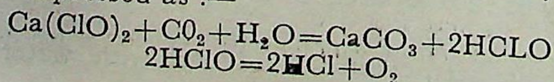
It is of the consistency of whitish powder of brittle lumps having a faint odour of chlorine and disagreeable saline taste. It contains, when fresh, 35% of available chlorine but it deteriorates soon, if it is not protected from air. About 30 grains of bleaching powder is required for sterilisation of 100 gallons of water. Then its strength (32 lbs. of bleaching powder for a million gallons of water) will be one part per million parts of water. It may be added that chlorinated lime will not clarify turbid water. Polluted water should therefore first be treated with preliminary filtration and then subjected to chlorination.

The amount required to disinfect water effectively varies and depends upon a number of factors, namely the quality of the water just before disinfection, nature of purification desired, amount of oxidisable matter present and the method of admixture. If water contains organic matter, more bleaching powder is necessary. After chlorination, all evidences of chlorine must disappear before the water is allowed for consumption.

A filtered water supply usually requires not more than 0.25 parts of chlorine per million parts of water which is equal to 8 lbs. of bleaching powder. But for a water containing iron, peaty matter or of high oxygen absorbing capacity, it will require several times more of this strength.

The exact nature in which bleaching powder acts on water is complex. Its germicidal effect is due to the following factors :—

(*i*) Some of the hypochlorites in the presence of carbon dioxide and water evolve nascent oxygen chemically; the reaction may be expressed as :—



$$Ca(ClO)_2+C0_2+H_2O=CaCO_3+2HCLO$$
$$2HClO=2HCl+O_2$$

(*ii*) Free chlorine is liberated which acts as a germicide.

(*iii*) When hypochlorites come in direct contact with ammonia or aminoacids of the organic matter, *chloramine* is formed, which is a powerful germicidal agent.

When bleaching powder is used for purification of water on a large scale, the requisite quantity of powder is dissolved and mixed with water in a mixing tank. The mixture is allowed to flow into a storage tank, where it is taken to the main water supply.

In India bleaching powder is largely used for sterilising wells, tanks, canals or rivers especially when cholera is raging in the rural area.

In case of a well :—Calculate the amount of water available in gallons by the formula :— $D^2 \times W \times 5$=gallons of water.

D=Diameter of well in feet. W=Depth of water in feet.

Roughly speaking 30 grains of bleaching powder are required for sterilizing 100 gallons of water. The required quantity of bleaching powder is dissolved in a bucket of water and the solution poured in the well, the water is then agitated thoroughly.

In case of a tank :—A cubic foot of water contains 6 gallons. Calculate the amount of water in the tank by the following formula :—Length $\times$ breadth $\times$ depth $\times 6\frac{1}{4}$=gallons of water.

In the case of a big tank :—Two ounces of bleaching powder are required for sterilizing 10 running feet of water. Supposing there is a square tank with each of its side 120 ft. long.

The total length of the sides will be $120 \times 4 = 480$ running feet.

So it will require $\frac{480 \times 2}{10 \times 16} = 6$ lbs. of bleaching powder.

In case of a running stream :—66 lbs. of bleaching powder is required per mile of stream water. The requisite quantity of bleaching powder is taken in a sack and is allowed to dissolve in the stream water at a high point.

(*b*) *Electrolytic Hypochlorites* :—These are formed by electrolysis of water containing definite proportion of sodium and magnesium salts. Electrolytic Chlorogen is recommended for sterilisation of wells and other water supplies.

(*c*) *Chlorine Gas* :—This gas is formed on a large scale by electrolytic decomposition of salt solution. The moist gas is stored in steel cylinders. One part of chlorine in one million parts of water is usually sufficient to sterilise water successfully in about 30 minutes.

The apparatus used for administering chlorine gas to water supplies is known as "*Paterson's Chloronome.*" The gas cylinder

is attached to the apparatus, the gas is conducted through the Chloronome to nearly the bottom of the absorption tower; this glazed earthenware tower is filled at the top with a water distributing tray and packed with pumice stone. A small trickle of water is uniformly distributed over the layer of pumice stone and in its downward flow absorbs the measured quantity of chlorine gas. The chlorinated water then flows through a chlorine resisting rubber or earthenware pipe and is uniformly distributed through the main body of the water to be disinfected.

There are several advantages of sterilising water with chlorine gas, over the hypochlorite solution, especially when a large quantity of water is to be sterilised daily, which are as follows :—

1. Chlorine gas, in pure form and in a concentrated state can be stored for a very long period without deterioration while hypochlorite of lime deteriorates soon.
2. The gas occupies very much less space.
3. A precise dose can be administered without any difficulty.
4. Labour cost is reduced to the minimum degree.
5. Dry chlorine gas has no effect on metals, but when it comes in contact with moisture it sets up virulent corrosion immediately.

(*d*) *Super Chlorination and Dechlorination* :—Here a much larger dose of chlorine is given (two parts of free chlorine per million gallons of water with a contact for 15 minutes, in place of 1 part per million gallons with a contact for half an hour). Excess of chlorine is neutralised by the addition of a dechlorinator like, anhydrous sodium thiosulphate (0.5 grams per 100 gallons), sulphuric acid gas, etc. Dechlorination removes all taste due to chlorine. This super and dechlorination destroys any unpleasant taste or odour which the water may have before treatment.

Horrock's Test :—This test is carried out for finding out the quantity of bleaching powder required to sterilise a known volume of water. First of all make a standard solution of bleaching powder in the black cup supplied with Horrock's Apparatus. The other six white cups are filled with water to be sterilised. The standard solution of bleaching powder is now added, drop by drop, one drop to first cup, two drops to the second, three drops to the third and four drops to the fourth cup and so on. The contents of each cup are thoroughly stirred and allowed to stay for half an hour. Next, indicator (cadmium iodide and starch solution) is added to each cup and contents stirred again. Some of the cups out of six white cups will show no colour, while others would show blue colour. Let us suppose, cups 1st and 2nd show no colour. But subsequent cups—3rd, 4th, 5th and 6th show blue colour. The number of cup showing definite colour, indicates number of scoopfuls of bleaching powder

required to give one part of free chlorine per 100 gallons of water, at the end of contact for half an hour with that water. Each scoop has a capacity of 2 gms. In the above case 3 scoopfuls or 6 gms. of bleaching powder will be required to sterilise 100 gallons of water.

Ortho Tolidine Test :—This test is done after chlorination of water, to know whether water has been sufficiently chlorinated for sterilisation or not. A sample of chlorinated water is taken in a test tube and 2—3 drops of Ortho Tolidine are added to it. The appearance of yellow colour will indicate that sufficient chlorination has been done. Appearance of red colour will indicate excess of chlorination.

2. *Ozonisation* :—The water must be clear and free from any suspended impurities. It is necessary to treat water first with alum and then to subject it to rough filtration, so as to eliminate all suspended matter before ozone is applied. Ozone is prepared in a chamber by a silent electric discharge. 1 to 3 milligrams of it is necessary for the purification of one litre of water. Ozone oxidises the organic matter and destroys water bacteria and pathogenic organisms. It does not clarify water and has practically no action on mineral salts. It is sometimes used for purification of the water of swimming baths which is done by a plant (ozoniser) in which ozone is produced from air, by means of high tension current and a steriliser in which water and ozone are admitted near the base. It is a very powerful germicide but is costly. It is therefore not suitable for purification of water on a small scale.

3. *Ultra Violet Rays* :—They have the power of destroying water bacteria without producing chemical changes. They exert their action only when the water is fairly clear and bright.

These rays are obtained from a mercury vapour quartz lamp.

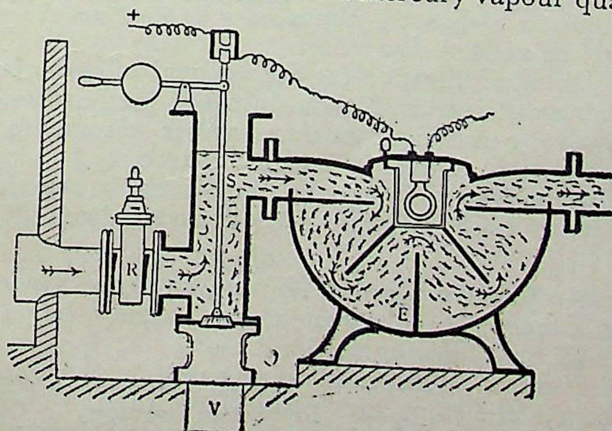


Fig. 8—Ultra Violet Rays Sterilisation of water :
R-Supply valve; V-Deviation valve; S-Solenoid; E-Baffle plate; L-Lamp.

Water, which is to be sterilised, is allowed to flow slowly, past the lamp enclosed in a tube made of fused rock crystal or quartz so that it may be directly exposed to the action of the rays, which are capable of passing through the rock crystal or quartz tube.

4. *Katadyn-Silver Process* :—Certain metals, in infinitesimal doses, act as powerful germicides which have been described as "Oligodynamic Action". Katadyn is the name given to an activated form of silver, which is made to deposit on particles of sand. In this process, minute quantities of silver go into solution in the form of silver ions which attract oxygen from the air dissolved in water and bacteria are killed by oligodynamic action.

Several types of appliances are available for sterilising water by this process; the simplest vessels used for the purpose are white glazed sterilised bottles or red porous earthenware pitchers. The water is passed through a filter containing this katadyn sand and is sterilised within 2—12 hours. Different types of instruments are available. The "Bead" type steriliser contains the elements in the form of katadyn covered beads threaded on silver wire. For this treatment only clear water is used. It also removes odours.

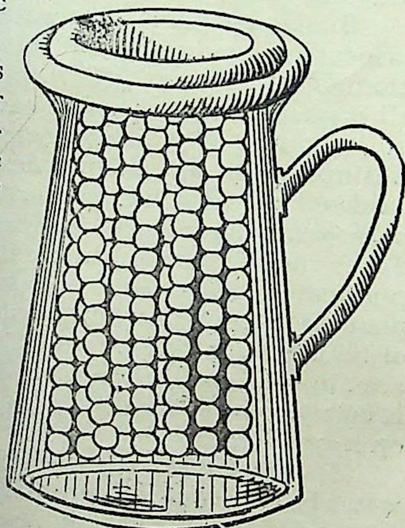


Fig. 9—Katadyn bead type Steriliser

5. *Adsorbents* :—Since times immemorial charcoal has been used as a medium of filtration for the removal of bacteria, odour, colour etc., from the water. Now-a-days activated carbon is being used for sterilising municipal water supplies in many towns. If used for a long time it loses its porous character, by clogging in its interstices a jelly like mass. But it can be reactivated by treating it with a hot solution of sodium hydroxide or with steam.

Domestic Purification of Water—In those places where waterworks cannot be constructed, water may be purified on small scales by the following methods :—

1. *Distillation* :—This method is used in chemical laboratories, on board the ships and places like Aden. The distilled water, being flat and insipid owing to loss of dissolved gases, requires to be aerated before use. It also acts readily on metals

such as zinc, copper, lead, etc.

2. *Boiling* :—This removes solid matter such as chalk, obnoxious gases and organic matter and kills pathogenic organisms. Boiling involves a large expenditure on fuel. Boiled water is flat and tasteless. It should be aerated before use. It is adopted as a precautionary measure in the presence of an epidemic of water borne diseases.

3. *Filters* :—(*a*) *Straining through Muslin Cloth* :—It is objectionable as it cannot prevent passage of bacteria, foul gases and finely divided solid particles. Besides, the cloth is not usually kept clean.

(*b*) The other filtering materials used are charcoal, sand, silicated carbon, porous iron, etc. Charcoal is very much used as a filtering medium. It is, however, not the best, as it absorbs impurities from the water or air and becomes a source of infection if not often cleaned with boiling water.

(*c*) *Filtration of water by 'Three Pitcher System'* :—Three pitchers are placed one above the other on a wooden stand. The top pitcher containing sand, is filled with water which percolates through a hole made at its bottom, along with a piece of cloth or cotton plugged into the hole, into the second pitcher which contains a mixture of sand and vegetable charcoal. Water passing through the layers of sand and charcoal percolates through a hole at its bottom into the third, viz., the lowest pitcher. This last pitcher now contains filtered water. It is very difficult to look after the cleanliness of the contents of these pitchers in private houses. Hence this system of pitcher filtration is not recommended.

(*d*) *Domestic Filters* :—They should be made up of porcelain, clay and infusorial earth and moulded into bougies or candles. They must keep back all germs. The essential features of a good filter are :—

1. It should be strong, compact, simple ; all parts being easily accessible for cleansing.
2. It should be efficient to keep back all germs.
3. It should be cheap and its purifying power fairly lasting.
4. The filtering medium should not require frequent changing.
5. It should not impart anything injurious to water.

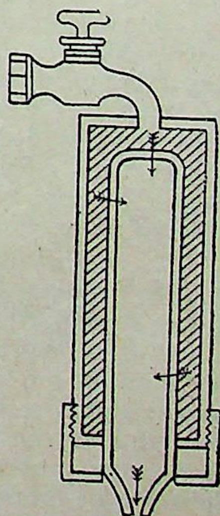


Fig. 10
Pasteur's Chamberland Filter.

The main types of filters are :—

1. *Pasteur's Chamberland Filter* :—This is made of fine glazed porcelain and consists of porous tubes or bougies. These tubes can be

screwed on to a tap. They should be cleaned by brushing with hot water and then steri-lised by boiling water. Muddy water should be first cleared, by passing it through closely packed coarse sand filter. This filter holds back all kinds of bacteria present in water but does not affect the chemical composition of the constituents dissolved in water. Its action is merely mechanical. It is a fairly reliable filter.

2. *The Berkefeld Filter* :—It consists of a cylinder made of infusorial earth better known as "Kieselgurh". The cylinder or candle wears thin by constant cleansing and gradually ceases to filter efficiently. It is more rapid in action and it does not require an additional pressure. Candle should be sterilised by boiling after every third day.

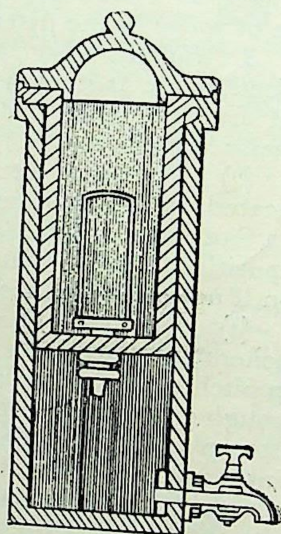


Fig. 11
Berkefeld Filter.

(*e*) *Chemicals* :—The following chemicals are used for purifying water :—

1. *Alum* :—It is largely used to purify muddy water. 1--4 grains are sufficient to add to each gallon of water. Alum when added to water containing calcium carbonate, which is present in all waters is decomposed and insoluble salts of calcium sulphate and aluminium hydrate are precipitated carrying with them suspended impurities, bacteria, and leaving the purified water clear.

2. *Copper sulphate* in the proportion of 0.1 to 0.25 parts to 1,000,000 parts of water prevents the growth of algae and other vegetable growths which give rise to odours and unpleasant taste of stagnant water. It is put in linen bags attached to ropes and strings and drawn through the water to be treated. It has, however no effect on organisms of water borne diseases, for example, cholera, typhoid, dysentery etc. Copper Chloride is considered more efficacious to stem them.

3. *Calcium Oxide* (*Quicklime*) :—Some people prefer slaked lime to ordinary lime. The quantity of slaked lime for sterilising water is proportionately reduced if the contact of salt with the water is to be prolonged. 6 grains of slaked lime will sterilise a gallon of soft water. Quicklime is cheap, easily procurable and is highly recommended for disinfecting the water of a well or a tank at the time of an outbreak of cholera in villages. It hastens the process of precipitation of iron in the water. It should however be noted that whiting chalk or carbonate of lime are useless for the purpose.

4. *Chlorine* :—When added to water in strength of 1 in 2

millions parts, chlorine gas is said to kill all disease producing germs. This is a very cheap and convenient method. Instead of chlorine gas, bleaching powder or hypochlorite of lime may be used in proportion of 30 grains to 100 gallons. Some times chloramine (N_2HCl) which is produced by the action of ammonia on chlorine is used instead of chlorine alone. For domestic purposes, prepare a stock solution by taking one tea spoonful or one drachm of bleaching powder and mixing with a pint *viz.* 20 ozs. of water. 5 drops of this stock solution are added to a pint *viz.* 20 ozs. of water and allowed to stand for 30 minutes. Some tablets have been manufactured with various names as Halazone, Chlordechlor etc., for chlorination of water on a small scale.

5. *Bromine* :—. 06 grains of bromine when dissolved in potassium bromide and added to a litre of water kill bacteria in five minutes. The offensive smell of bromine may be removed by further treatment of water with sodium sulphite and sodium carbonate solution.

6. *Iodine* is used in doses of 2 parts per million to destroy micro-organisms present in water. Sodium hyposulphite should be added after 15 minutes to neutralise the free iodine of sodium which renders water fit for drinking.

7. *Nesfield Tablets* :— A 2 grains tablet of iodine and iodate of sodium and the same quantity of citric acid when added to 4 gallons of water will kill cholera and typhoid germs in a few minutes. The free iodine present in the water may be removed by the addition of sodium hyposulphite.

8. *Potassium Permanganate* :—It oxidises organic matter and also serves as a deodorant. 0.5 parts of this salt added to 100,000 parts of water is sufficient to destroy 98% of micro-organisms in 4 to 6 hours. It was largely used for disinfection of wells. 4—6 ozs. of it is used for a well, so that water will give a proportion of ½ oz. per 1000 gallons of water in the well. It is better to treat the water of the well with the chemical in the evening so that it may be ready for use the following morning, when it should have a faint pink tinge, if the dose has been right. If smell reappears in the well water after 2 or 3 days potassium permanganate treatment should be repeated. It is however not suitable for sterilising large volumes of water.

Examination of Water :—For hygienic purposes the examination of water is generally done under the following heads :—

A. Physical Examination.
B. Chemical Examination.
C. Microscopical Examination.
D. Bacteriological Examination.

Collection of Sample :—For chemical analysis, water should be collected in a four pints Winchester quart bottle with a stopper. The bottle should be cleaned with dilute acid and then

washed thoroughly with good tap water. Before it is filled with the sample it should be rinsed 3 times with the water to be collected.

In case of *bacteriological examination*, sterilised glass stoppered bottles holding about 8 ozs. of water should be used. If sample is taken from the tap, the tap should be cleansed with a cloth and thoroughly flamed. Before the sterilised bottle is opened, the neck and the stopper should be flamed with a spirit lamp and stopper removed with sterilised forceps, the bottle filled and the stopper again passed through the flame before being replaced. The sample must be sent to the laboratory in an ice box without delay and should be examined in a bacteriological laboratory within six hours of collection. Heat and delay will cause multiplication of some bacteria and death of others and some chemical changes will take place.

In taking the sample the following rules should be observed :—

(*a*) If from a tap, it should be taken from the lowest tap and the water should flow for five minutes before the sample is collected.

(*b*) The contents of a cistern are no criterion of the purity or otherwise of a water supply. The specimen must be taken direct from the main.

(*c*) When taken from a well, river, or a lake take the sample by placing the bottle well under the surface i.e. a foot below the surface, and sufficiently away from the bank.

(*d*) In case of a well, pump the water out for an hour or two and then wait for the well to get refilled so as to get a genuine sample of ground water, which has remained stagnant for a long time in the well.

There is a special bottle with a float for taking a sample of water from the river, tank or well, which is provided with a contrivance by which the stopper does not come out, till the mouth of the bottle does not reach well below the surface.

After filling the bottle the stopper is to be replaced and secured by a rubber cap. No sealing wax or grease should be applied to the stopper. Label the bottle with a number and send to the laboratory as expeditiously as possible. The following information should always be furnished with the sample of water :—

(*a*) Number written on the bottle containing the sample.
(*b*) Time and date of collection of sample.
(*c*) Source of water whether from a river, well or tank.
(*d*) Geological formation of the neighbourhood of the source of water so far as known.
(*e*) Description of supply should include the following factors

in the case of well, its depth, diameter, strata, through which it is sunk, mode of its use and the depth of water etc., should be noted.

(*f*) Possibilities of impurities getting into the well i.e, cess-pool, manure heap etc.

(*g*) Metereological conditions whether there had been any recent rainfall or flood etc.

(*h*) Statement of an out-break of any water borne disease in the neighbourhood or any special reasons required for analysis.

A. **Physical Examination** :—Note the colour, clearness, lustre or brilliance, taste and smell. This by no means be attributed as final and should not form the basis of opinion.

B. **Chemical Analysis of Water** :—Analysis is made to determine :—

1. The amount of inorganic salts in solution, which determines the hardness of water and types of hardness.
2. The nature and amount of organic pollution.
3. The percentage and amounts of poisonous metals.

The chemist determines reaction, the type and degree of hardness, the presence of chlorides, nitrites, nitrates, ammonia (free and albuminoid) and the metals such as lead, copper, iron, calcium etc., before giving opinion.

The complex nitrogenous constituents of excreta as well as dead animals and vegetable remains are broken by force of nature into simpler bodies. This is a process of fermentation carried on by various bacteria always present in the soil and the chemical changes, though complex, consist largely of oxidation. Certain stages in the process are marked by the formation of simple products stated in the order of their appearance as ammonia, nitrites and nitrates.

By examining water for their presence as well as their amount the chemist can form some idea of the extent of organic pollution of water and as to whether such a pollution was recent in origin or not. If the pollution was recent there will be preponderance of ammonia and nitrites than nitrogen in the form of nitrates. This is important as by the time the stage of nitrates formation is reached, no pathogenic bacteria can survive in the water.

From the relative quantities of such nitrogenous products present in the water, the chemist can also form an idea, whether the organic pollution was mainly vegetable or animal in origin. The former has little significance from the sanitary point of view but the evidence of the latter indicates the danger to health. As sodium chloride is present in urine, the analyst, for examining the water for evidence of excretal products always examines the

quantity of chlorides present; but he must remember that they might have entered, the water from other sources i.e., sea water, if the water supply happens to be near the sea or is derived from certain strata of the earth containing chlorides. If repeated examinations of water show a constant quantity of chlorides and then there is a sudden increase in the amount, it excites a suspicion that contamination with sewage might have occurred.

C. **Microscopical examination of water** :—The sample is centrifuged and the deposit is seen under a microscope. The presence of spores of mycelia if found is due to contamination of water with sewage and the most suspicious elements are the remnants of vegetables used for food and fibres of cotton, linen, wool etc. Animal substances i.e., wool, hair, yellow elastic tissue etc., generally indicate recent contamination.

D. **Bacteriological examination of water** :—The main object of bacteriological examination of water, is to find whether excretal pollution is present. A single examination is of value only when a water is so bad as to justify condemnation. A routine examination consists of plate count and presumptive coli aerogenous count, as organisms of coliform group have been found to be most useful for this purpose. The sewage bacteria can be divided into two groups *viz.* :—

(a) Organisms of intestinal origin i.e., faecal coliform group, faecal streptococci and pathogenic organisms, e.g., vibrio cholera, Bacterium dysentery, Bacterium typhosum etc.

(b) Sewage bacteria proper e.g., proteus group of organisms etc.

Standard for filtered pipe water :—

(a) Excellent water = No coliform bacteria in 100 cc.
(b) Satisfactory water = 1 to 2 coliform bacteria in 100 cc.
(c) Suspicious water = 3 to 10 coliform bacteria in 100 cc.

Tube wells and deep wells should conform to the above standards. It is very difficult to lay standards for shallow wells and tanks.

Public Swimming Baths:—Of recent years there has been a public demand for large number of swimming baths ; many of which are privately run.

Model baths should be such as to allow easy cleansing. The margin of the bath should slope away so as to prevent contamination by dirty water. The surface should be kept free of growths and deposits. There should be a channel round the bath for the bathers to spit into. There should be ample urinal and water closet accommodation, along with shower baths and dressing rooms. There should also be a foot bath with hypochlorite solution.

No bather be allowed to enter the bath, without a previous soaping, shower bath and foot bath. Fouling the water by spitting or passing urine in the bath are highly objectionable. No person having any intestinal infection, contagious disease or skin disease (including fungus infection of feet) sore eyes, running ears etc., should be allowed to use a public bath until completely free from infection.

At swimming baths the water should have good transparency, showing up the bottom and the sides of the ponds clearly. The water should conform to the standard of drinking water i.e., Bacillus coli absent in 1 c.c.; no other organisms to exceed 1.000 per c.c.

They should have either a water supply which ensures a continuous fresh flow through the bath or more commonly, a system whereby the water in the bath circulates continuously from the bath through a filter and back again to the bath.

Most baths are now chlorinated continuously during the whole period of bathing and the dose should be sufficient to maintain the strength from 0.3 to 0.5 part per million parts as a bigger dose will be irritating to eyes, the nose and the skin. Filtration through Katadyn or treatment by ozone is also useful. Over dosage of ozone should be avoided.

As there is no proper arrangement for purification of water in swimming baths so the following diseases are attributed to their use.— Conjunctivitis sinusitis, otitismedia and infectious sore throat. Rarely typhoid fever, dysentery, skin diseases vulvovaginitis and trachoma have also been traced. Poliomyelitis may be contracted in swimming pools. Certain skin and respiratory diseases, swimmers'itch and venereal diseases are also sometimes contracted.

Water Borne Diseases :—1. Diseases caused by micro-organisms :—The commonest diseases are intestinal namely typhoid, paratyphoid, dysentery, diarrhoea and cholera. The virus of infantile paralysis is excreted in faeces and there is a good deal of evidence to show that it may be water-borne.

2. Diseases caused by parasitic ova :—The eggs or developed embryos of the eggs of round worms and tapeworms are usually carried by water. Entzoal diseases as nematodes flukes, filharzia, guinea worm and hook worm infections are carried through water. The cyst of amoeba causes amoebic dysentery. In addition water forms the medium in which the mosquitoes which transmit malaria and yellow fever lay their eggs.

3. Diseases caused by Inorganic matter :—Diarrhoea may be caused by excessive amount of sulphates and poisoning may occur from lead or other metals. Obstinate constipation may

occur due to excess of iron in water. Certain inorganic salts such as iodides and fluorides are essential for health. Deficiency of the former gives rise to goitre and that of the latter to dental caries in childhood whilst an excess appears to cause brittle bones with a tendency to spontaneous fractures.

4. Diseases caused by organic matter : Diarrhoea and gastric disturbances are occasionally due to an excess of vegetable matter in water or to entrance of sewage from drains.

Hygiene of Ice Making :—Ice may become contaminated at the factory or during delivery. The water used for its manufacture must be above suspicion. No ice factory should be licensed unless the water to be used for manufacture of ice is pure and wholesome. The ice should be sampled at the factory for bacteriological examination from time to time. The containers in which water is frozen should be scrupulously clean. They should be scrubbed out weekly and sterilised by steaming. The workmen should wear clean overalls during the work and cleanliness as regards their hands and nails should be observed. Adequate latrine accommodation should be provided for the staff. No typhoid carrier should be employed in the ice factory. Spitting should be prohibited. Delivery should be effected in closed vans.

There is always a possibility of pollution of ice even in a wellconducted establishment. The public should never keep foodstuffs in direct contact with ice or put ice into drinks to cool them. Food stuffs or drinks should be cooled by being kept in an iced chest in which there are two separate compartments, one for ice and other for the foods.

Aerated Water Factories :—Three processes are involved in the preparation of aerated waters (*a*) the cleaning of bottles (*b*) the preparation of syrups (*c*) the bottling of the products. During any of these, nuisance or danger to public health may arise. So these factories must be licensed. It is preferable to have separate rooms for each of these processes. The factory should be well lit and ventilated and free from flies. All workers must wear scrupulously clean clothes and observe cleanliness regarding their hands and nails. The floor should be made up of smooth impermeable material and flushed regularly at the end of day's work. The internal walls should be painted with waterproof paints. Adequate lavatory and washing accommodation with soap and nail brushes should be provided for workers separately from the factory.

Bottle washing :—Three tanks should be provided for washing the bottles. The first of those is filled with pure water to which washing soda has been added,—½ oz. to a gallon of water. All bottles on return to the factory are immersed in this solu-

tion to soak. When the labels have come off, the bottles are transferred after having been wellscrubbed with brush to the second tank which contains clean water mixed with potassium permanganate. They are scrubbed internally with good bottle brushes, rinsed out and placed in third tank with plane water. Here they are again rinsed, inverted on a draining rack and allowed to dry.

Syrup room :—It must be fly proof. It should have a table having a smooth, clean and washable top. Strainers should be washed daily in clean water, boiled and kept in a dust proof cupboard when not in use. Syrup containers should be kept in an ant and flyproof cupboard. The water supply of the factory must be above suspicion, preferably from the municipal water-supply.

Bottling :—There are two types of bottles in use. The crown capped bottles are hygienic because the whole of the top of the bottle is covered over by the cap. Capping machines are needed for the insertion of the caps. There are two types, one fed with a supply of caps automatically, which are best and the other requiring the insertion by hand, of each cap, which may be infected by the forefingers. The other types of bottles, made gas-tight by means of a glass ball fitting against a rubber ring are most insanitary and extremely difficult to clean. The use of such bottles should be abolished.

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CHAPTER II

AIR AND VENTILATION

Air is absolutely necessary for the maintenance of life. The two main functions of the air are interchange of gases in the process of respiration and regulation of body temperature.

Air is a mechanical mixture of gases. Pure air has approximately the following composition :—

Oxygen	20.95%
Carbon dioxide	0.03 to 0.04%
Nitrogen	79.0%
Water vapour	Varies with temperature
Ammonia Ozone and Argon	Variable, in traces.

In the open air this composition remains remarkably constant, owing to diffusion of air currents and due to the fact that the plants by virtue of their chlorophyll, take up carbon-dioxide from the air, and give off oxygen. thus compensating for the consumption of oxygen and formation of carbon dioxide which is always going on as a result of the existence of animal life, combustion etc. Oxygen is an essential constituent of air necessary for all life, the inert nitrogen simply acts as a diluent of oxygen; the only exception to this rule being certain types of bacteria which thrive in the absence of oxygen *viz* anaerobic bacteria. Water vapour is always present in the air. Its amount varies widely and depends chiefly upon the quantity of water available for evaporation i.e., on rainfall. It is present more at sea than at land. At certain temperature air can hold only a definite amount of water vapours. The air is said to be saturated when it can hold no more amount of water vapours at a particular temperature and at that point, its humidity is said to be 100%. About 65 p.c. to 75 p.c. humidity is considered as best for health.

Physical properties of air

1. *Charle's law* :—"The volume of a gas or mixture of gases of the atmosphere varies directly as the absolute temperature, provided its pressure remains constant.'' Absolute temperature is obtained by adding the figure 273 to the temperature expressed in centigrade degrees. Air, on account of expansion due to heat, necessarily becomes lighter and therefore tends to rise up and cold air rushes to take its place. This phenomenon is to a large extent the cause of the blowing of winds. Ventilation also in many cases depends upon this principle. In air analysis also effects of temperature on the air must be remembered and taken into consideration.

2. *Boyle's law* :— "The volume of air varies inversely in proportion to its pressure provided the temperature remains constant."

3. *Grahm's law* :—Air diffuses in accordance to Grahm's Law *i.e.*, "Gases diffuse at a rate inversely proportional to the square root of their densities."

The power of air to diffuse through the brick walls of buildings etc., is of minor importance in ventilation, but it is an important factor in maintaining the composition of air as constant and removing impurities whenever different masses of air come into direct contact with each other and the air is not moving sufficiently to produce that effect without diffusion.

The factors regarding purification of air, to bring it to a uniform composition, are :—(a) The wind, which dilutes, sweeps away or aspirates the impurities and gets replaced by pure air.

(b) The rain, which washes the air and removes gases as well as suspended impurities.

(c) Oxygen and ozone, which oxidise the organic matter present in the air.

(d) In sunlight, chlorophyll present in green leaves of the plants absorbs carbon from carbon dioxide of the atmosphere and gives off free oxygen. But at night this process gets reversed.

Impurities of air

The chief impurities in the air are due to :—

1. Respiration.
2. Combustion.
3. Decomposition of organic matter.
4. Dust.
5. Bacteria.

1. **Impurities due to respiration**—These are chiefly carbon dioxide, water vapours and organic matters. The proportion of gases in inspired and expired air per 100 parts is as follows :—

	Inspired air	Expired air
Oxygen ...	20.95	16.51
Nitrogen ...	79.02	79.09
Carbon dioxide ...	0.03 to 0.04	4.41
Water Vapour	Varies	Saturated
Temperature	Varies	At body temp.

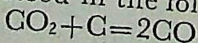
On an average a man respires about 18 times a minute and at each breathing an adult gives out about 22 cubic inches (500 c.c.) of air. The expired air contains about 4.4% carbon dioxide more than that present in the fresh air. It loses about the same percentage of oxygen. On an average about 10 ounces of water vapours are given off from the lungs of a man within 24 hours, whereas skin excretes about 20 to 30 ounces within the said period. Respiration also raises the temperature of the air. When the amount of carbon dioxide in the air of a particular room rises

from its normal percentage, *i.e.* 0.04% to 0.06% the air becomes perceptibly stuffy to a person entering from fresh air and the occupants of the room begin to suffer from the usual symptoms complained of in over-crowded rooms *e.g.* drowsiness, headache, nausea, vomiting, etc. Formerly it was thought that these symptoms were caused entirely by the changes in the air by respiration, but now it has been established that the increase of carbon dioxide or the decrease of oxygen, or any of other changes mentioned above that accompany the increase of carbon dioxide from 0.04% to 0.06% are not sufficient by themselves or even in combination, to produce these symptoms, unless another condition, namely the stagnation of air, is also present in the room.

Air to which carbon dioxide has been artificially added in a ratio for more than 0.6% and containing other products of respiration does not produce the above symptoms provided the air is kept moving. It is concluded now that the movements and the stagnation of air play a large part in this matter and it is probable that the effects of moving air on the surface of the body are beneficial to health.

Expired air contains fewer microbes in ordinary quiet respiration, but people suffering from influenza, pneumonia, diphtheria, tuberculosis, etc., exhale those microorganisms in large numbers during coughing, sneezing, loud talking, etc.

2. **Impurities due to combustion** :—The chief impurity derived in the process of combustion by the oxidation of carbon of the air is carbon dioxide. Under certain conditions carbon monoxide is formed by combustion. The burning of coke especially in cast iron stoves is a source of carbon monoxide. As carbon dioxide is passed over hot coke it is reduced to carbon monoxide which is expressed in the following equation :–



$$CO_2 + C = 2CO$$

The carbon of the cast iron also acts in the same manner, reducing carbon dioxide to carbon monoxide which is poisonous and due to the fact that it is imperceptible, as it has no smell, makes it specially dangerous. Presence of 0.4% carbon monoxide in the air is sufficient to cause death. Carbon monoxide forms a stable combination with haemoglobin of the blood, thereby diminishing the oxygen carrying power of blood and that is how it poisons the body. About 6% carbon monoxide is present in the coal gas used for illumination purposes, therefore its escape has caused carbon monoxide poisoning. Moreover, it is also caused by incomplete combustion of the fuel.

Coal when burnt constitutes one of the main sources of the impurities of air. For complete combustion of one lb. of coal, 240 to 320 cubic feet of air is required. During the process of combustion 1% coal is given off into the air as fine particles of

carbon or soot and tarry products together with large quantities of carbon dioxide and carbon monoxide. The other products of combustion are carbon bisulphide, sulphurous and sulphuric acids, sulphuretted hydrogen, ammonium sulphide and water.

Air pollution by industrial smoke can be considerably prevented by adopting the following methods :—

(*i*) Use of smokeless fuels *e.g.* coke in boilers and furnaces.
(*ii*) Use of mechanical stokers or employment of skilled labour, for careful stoking of furnaces.
(*iii*) Provision of efficient furnace plants with accurately maintained draughts.
(*iv*) Enforcement of laws relating to smoke nuisance.

Artificial lights always give rise to impurities in the air. Coal gas is a popular illuminant. Purified coal gas is formed by the destructive distillation of coal and contains 46% hydrogen, 37% marsh gas, 7% carbon monoxide, 5% acetylene and ethylene and 5% nitrogen and sulphurous acid.

An ordinary gas burner consumes 6 cubic feet of gas and vitiates about 7200 cubic feet of air. This vitiation approximates the contamination of air by the breathing of three adults.

Burning of candles and oils add to the impurities of air by producing soot, carbon dioxide and water.

By the term "One Candle Power" is meant the light given out by a sperm candle burning at the rate of 120 grains per hour. This gives out 0.4 cubic foot of carbonic acid and also about the same quantity of water.

A sixteen candle power kerosene or paraffin oil lamp, while burning, will give off 4 cubic feet of carbon dioxide gas and will absorb about 6 cubic feet of oxygen.

The smoke generally consists of unburnt carbon particles, hydrocarbons, poisonous gases, pyroligneous bodies etc. Domestic smoke being rich in hydrocarbon soot and tar, adheres to the articles on which it falls ; that is why, it is very obnoxious and troublesome. Moreover, since the smoky atmosphere irritates the upper respiratory passages, it is responsible for the increase of mortality from pulmonary diseases particularly tuberculosis.

3. **Impurities due to decomposition** :—Animal and vegetable matters, when they putrefy, give off offensive poisonous gases such as carbon dioxide, hydrogen sulphide, ammonium hydrogen sulphide, carbon bisulphide, ammonia and marsh gas. These mostly emanate from cesspools, sewers, drains, stables, cowsheds etc. Bacteria, moulds and fungi grow rapidly in such air. Food and meat are soon tainted when exposed to it. Presence of 0.2% of hydrogen sulphide in the air may sometimes produce unconsciousness.

4. **Impurities due to dust** :—More or less poisonous gases and volatile effluvia and suspended matters are given off by certain trades and manufacturing concerns. The inorganic particles of dust to be met with, in the atmosphere are chiefly composed of silica, aluminium silicate, carbonate or phosphate of calcium, magnesium, sodium chloride, carbon, etc. Those found in the air of houses are from debris arising from the wear and tear of articles in domestic use, such as dust, soot and ashes. Mineral particles from the neighbouring factories may likewise find access into the houses.

Scales of epithelium, fibres of cotton, linen and wool, particles of hair, spores, pollen grains, etc., are sometimes found in inhabited but poorly ventilated rooms.

Particles of dust arising from filing of metals, stones, etc., add to the amount of suspended impurities present in the air. Dusty air can be cleansed by washing, just as rain washes the air. This is done by passing the air from a chamber fitted with water spraying jets. Thus by washing air two thirds of the suspended material can be removed.

5. **Bacteria** :—Microorganisms are found in the normal atmosphere. The great source of aerial bacteria is the soil which is teaming with microorganisms. They are emitted by coughing or speaking and after floating in the air at the most about 10 feet high they fall on the ground. Pathogenic microorganisms are not present in the atmosphere except in close proximity to patients whose expired air is charged with bacteria as in the cases of persons suffering from phthisis, influenza, etc.

The number of microbes present in the air of an occupied or a crowded room is mostly dependant upon the cleanliness of the occupants. House dust is more harmful than outside dust of the streets.

Examination of air :—This is done by the following two methods :—

1. *By the senses* :—It is important. Any man with a good sense of smell on entering the room will notice at once, whether or not the products of respiration or skin emanation from dirty people have polluted the air to an unhealthy degree.

2. *Patten-Koffer's Test* :—This method depends upon the fact that an alkaline medium like lime water or baryta water absorbs carbon dioxide, whereby its alkalinity gets diminished. Therefore difference in degree of alkalinity before and after the absorption of carbon dioxide from the air, gives an index of the amount of carbon dioxide present in the air.

Test :—Take a bottle with a capacity of 3950 cc. or of any other known capacity. Fill it with water and then enter the

room by taking the bottle along with you. Throw out its water and the air will automatically rush into it. Cork it. Neutralise it with lime water or baryta water and test its alkalinity.

Kata Thermometer :—It is contrived by Leonard Hill and consists of a large bulbed spirit thermometer graduated from 95 degree to 100 degree F and it is meant for measuring rates of cooling. Two such instruments are generally used :—

1. *Dry Kata* :—In this instrument the bulb is uncovered and it records the cooling power of air obtained by radiation and convection.

2. *Wet Kata* :—In this instrument the bulb is covered with a piece of wet silk cloth or fine cotton. It records the cooling power of the air obtained by radiation, convection and evaporation.

Reading :—The bulbs are immersed in test water of about 150 degree F temperature until the spirit rises into the small bulb at the top of the instrument. The excess of water is then jerked off, the wet bulb and the other part of the instrument is subsequently dried with a piece of cloth.

The time required for alcohol to fall from 100° F to 95° F is noted in seconds by a stop watch. At least four such readings are taken with each thermometer. The first reading is discarded and the average of other three is taken. Each thermometer has a factor and is marked with a letter F on the stem. The factor divided by the number of seconds occupied in 5 degree drop gives the rate of cooling expressed in millicalories per sq. cm. per second.

A fresh comfortable room has a dry kata cooling power of 5 to 6 and wet kata cooling power of 16 to 18 *i.e.*, 6 to 18 millicalories of heat are lost per sq. cm. of surface, per second.

If the room is preceptibly cool, the figure will be 8 and 22 whereas these figures will come down to 4 and 15 in case the room happens to be warm and stuffy.

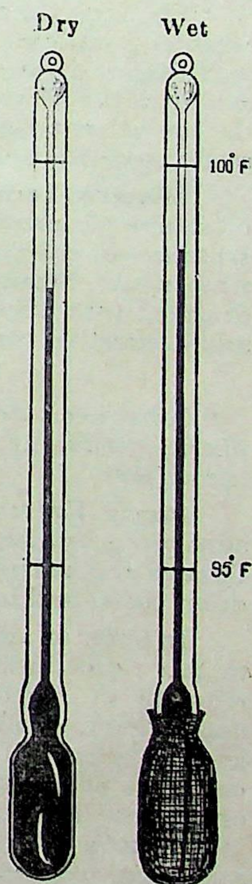


Fig. 12
Kata Thermometer
Dry & Wet

Eupatheoscope and Eupatheometer :—These are the latest types of comfort indicators. The former is rather cumbersome so the Eupatheometer is commonly used. It consists

of two thermometers filled with spirit, one having a glass bulb and the other silver metal bulb. Heat the bulb of each thermometer with warm water, till the spirit rises up in the top bulb. Wipe out the bulb, dry it, and suspend the black thermometer. Stand at a place as far from the instrument as is convenient and observe the fall of spirit from the upper mark on the scale to the lower mark. Use a special stop watch to time this and read from the small scale. Now suspend the silvered instrument and time its cooling. Note the reading upon the silver scale of the watch.

The equivalent temperature in degrees Fahrenheit is obtained by adding the two readings together. Thus the stop watch shows 35 when the black thermometer cools in 30 seconds and 20, if the silvered thermometer cools in 27 seconds. Hence the equivalent temperature is 35+20=55°F. Three or four such readings should be taken and the average obtained.

Effective Temperature :—It is defined as that temperature of saturated, motionless air which would produce the same sensation of coolness as that produced by the combination of temperature, humidity and air motion under observation. Places or zones with effective temperatures from 65°F to 70°F may be safely termed as comfort zones.

VENTILATION

It has been defined as the "Science of maintaining atmospheric conditions which are comfortable and healthful to the human body".

Internal Ventilation means the removal or dilution of the atmosphere which has become stagnant, warm and moist through the vitiating processes, by air which is comparatively drier, cooler and in motion.

In order to admit fresh air into the houses, it is necessary to take into consideration the ventilation of streets and surrounding of the buildings also which is called *External Ventilation*. This is ensured by making the streets wide and straight, keeping plenty of open spaces and parks especially in the congested part of the towns and by building the houses detached or separate from each other. This can also be helped by watering the streets to lay down the dust to prevent nuisance from smoke and by speedy removal of street and other refuse.

Satisfactory ventilation must conform to certain conditions, which are as follows :—

1. It must supply pure air from without.
2. It must keep the air within the room at a proper temperature and humidity and should maintain a continuous circulation.

3. It must be able to remove gases, odours, bacteria, dust, etc., which contaminate the air and dilute and remove the impurities produced inside the room through vitiating processes.

Effects of Living in Stuffy, Overcrowded and Illventilated Rooms :—The physical changes noticeable in vitiated air are therefore (1) a rise in temperature (2) increased humidity (3) stillness. These are apt to produce headache, inability to concentrate, drowsiness, lassitude, depression of spirits, loss of appetite, a tendency to catch cold easily and diminished resistance to infectious diseases. It is one of the causes of the prevalence of rickets in children. It has been proved beyond doubt that tuberculosis of lungs is especially related to overcrowding and insufficient ventilation.

Amount of Air Required for Ventilation :—The amount of air required for efficient ventilation varies and largely depends upon factors like size of the room, the number of persons occupying the room and amount of impurities present in the air requiring dilution and dispersion. Ventilation aids only in the removal of products of respiration and combustion. Whatever may be the impurities, presence of carbon dioxide is regarded as the chief index of ventilation.

When the amount of carbon dioxide present in air increases from 0.04% to 0.06% stuffiness begins to be perceptible. The limit of 0.06% *i.e.*, addition of not more than 0.02% carbon dioxide is regarded as a permissible limit of respiratory impurity. It has been assumed that air vitiated to the extent of 0.2 per thousand, which is still fresh and does not differ sensibly to smell from the outer atmosphere, can be breathed with impunity, but no further vitiation should be allowed.

Ideal ventilation may be said to be existing only when the supply of sufficient pure air to a room is ensured to prevent the amount of respiratory carbon dioxide increasing beyond a limit of 0.2 parts per thousand parts. The permissible limit of this impurity is held to be 0.2 parts per thousand or 0.0002 cubic ft. of carbon dioxide per cubic ft. of air.

Equation $D = \frac{E}{R}$

Delivery of the amount of fresh air available in cubic feet. = $\dfrac{\text{Amount of carbon dioxide exhaled}}{\text{Respiratory impurity per cubic foot of air}}$

If E=0.6 and R=0.0002

$$D = \frac{0.6}{0.0002} = 3000 \text{ cubic feet.}$$

Each individual requires 3000 cubic feet of air per hour so that the respiratory impurity may not exceed 0.2 part per 1000 parts.

Cubic Space :—A person requires generally 3000 cubic feet of air per hour. It can be supplied without causing a draught by changing the air three times per hour and as such 1000 cubic feet of space is allotted to each person.

If only 300 cubic feet of space per head be allowed then the air of the room will have to be changed at the rate of 10 times per hour which consequently, in cold weather, will cause an intolerable draught. It should be noted that where the available cubic space is large there is a comparatively lesser need of frequently changing the air.

The minimum cubic space allowed per head is as follows :—

Soldiers	600	cubic feet
Army hospitals	1200	,, ,,
Infectious diseases hospitals	2000	,, ,,
Lodging houses occupied day and night ...	400	,, ,,
Lodging houses occupied at night only ...	300	,, ,,
School rooms in countries having warm climate throughout the year	100	,, ,,
School rooms in cold countries ...	200-300	,, ,,

Floor Space :—Ventilation depends upon the fact that the warmed vitiated air rises up, except in very hot weather. The warm air, after rising about 12 feet high, gets cooled and falls down again. So in calculating cubic space, any height above 12 feet should be discarded. This does not mean that the rooms should not be more than 12 feet high. In the Punjab during very hot weather, the rooms with a height of 20 feet or more, are very good. Moreover, if mechanical methods of ventilation are adopted, height above 12 feet is regarded as useful. By keeping 12 feet as the limit of height, it will follow that the floor space would be equal to 1/12th of the total cubic space.

Amount of Fresh Air Required by Animals :—A horse or a cow ought to be provided with about 10,000 to 20,000 cubic feet of air per hour, in the ratio of 20 to 25 cubic feet per hour per lb. of body weight.

Amount of Fresh Air Required for Artificial Lights:—As candles, kerosene oil lamps, coal gas burners, etc., consume oxygen of the air while burning, so these must also be taken into consideration while arranging for provision for their ventilation. For an ordinary oil lamp and a gas burner 2000 and 2250 cubic feet of air are required per hour respectively, Electric light is considered as best from hygienic point of view as it has practically no effect on the air of the room. All other lights are more or

less dependant upon the absorption of oxygen from the air and vitiate the atmosphere by certain products which affect the health to a greater or lesser degree.

Amount of Fresh Air Required for the Sick:—On an average 3750 cubic feet of air per hour is required for a sick person.

SYSTEMS OF VENTILATION

A.—Natural Ventilation :—This is greatly achieved by building houses having sufficient open space and by having a large number of windows opening direct into the open air. It largely depends on the following three natural forces :—

(*a*) *Diffusion of gases* :—Gases diffuse inversely as the square root of their densities so the air of a room diffuses through the cracks and crevices of various doors and windows of a room, even though they are closed. But under ordinary circumstances, the diffusion, if there be any, is very small. So one cannot depend upon diffusion alone. Diffusion causes the gaseous impurities of the respired air to mix up with the fresh air of the room until homogenity is established. Diffusion however, does not affect the suspended matter present in the air which tends to fall back towards the earth in a still atmosphere, due to force of gravity.

(*b*) *Effect of differences of temperature* :—When air is heated it expands and becomes lighter. This hot air rises up and the cold fresh air rushes in to take its place.

If the air of a room be heated by fire or gets heated from the products of respiration of men and animals or be made more or less moist, it tends to expand and rises up or escapes through all available openings, cracks, or crevices. The outer colder air rushes in through outer openings until temperature of both outside and inside air becomes equal. Therefore, in all methods of ventilation, based upon this force, suitable and adequate inlets for fresh air and outlets for the escape of impure air must be provided. This method is more relied upon in cold countries where coalfires are used and the external and internal difference of temperature of the room is relatively high.

(c) *Perflation and Aspiration* :—Winds are very powerful ventilating agents and they act in two ways viz., (i) by perflation and (ii) by their aspirating action.

Perflation means the setting up masses of air in motion and forcing them through open doors, windows and porous bricks into the room as a result of movement of natural air currents. By means of this force the building can be rapidly and continuously flushed with fresh air. Cross ventilation means free perflation between windows and other openings,

placed opposite to each other. But natural cross ventilation is not feasible in the case of houses having back to back construction. In warm climates, as in India, where the inside and outside temperature of a room is more or less the same, ventilation is promoted by perflating action of the air through doors and windows and as such care should be taken that as far as possible these should be facing each other. The only drawback against the wind as a ventilating agent is that the movements are very uncertain and thus they are difficult to regulate. This method has been advantageously utilised in the ventilation of holds and cabins of the ships at sea. Breeze is produced on account of the ship's motion, which is conducted below by means of tubes and the vitiated air escapes through its various openings.

Aspiration means the suction action of the wind which draws air out of a space, creating therein a partial vacuum and thus fresh air rushes in, to take its place and a continuous current in perpendicular direction is thus set up.

Inlets and outlets :—The openings through which process of ventilation is carried out are known as inlets and outlets. Inlets are intended for the entrance of pure air and the outlets for the escape of vitiated air.

In tropical countries, during hot weather, particularly when the humidity is high and there is air stagnation, ventilation becomes imperfect. Electric fans are therefore used for agitating the air of the room which cause evaporation of perspiration, imparting thereby a feeling of comfort. In addition, these fans help circulation of air of the room and force the vitiated air out through the ventilators etc. They may be used in the form of ceiling fans or table fans. They are also sometimes called as *agitator fans*.

In warmer climates the doors and windows provide all the necessary ventilation. Free ventilation between windows and other openings placed opposite to each other and at the same height ensures cross ventilation and it should be encouraged. In colder climates the doors and windows have to be often kept closed and therefore special arrangements must be made for providing inlets. Usually the chimney of the room serves the purpose of an outlet, but if it happens to be insufficient for the purpose, then other outlets must be provided in the room.

Inlets :—The area of inlets per head should be about 24 square inches and the total inlet area should be always greater than the total outlet area in order to reduce the tendency for draught. Inlets should be provided preferably at a height of 5 feet above the floor level so that the entering cold air is admitted at about the level of the head of a person sitting in a room. These should be placed in such a position that the

air supplied is pure and not polluted before admission. The incoming air should be given an upward direction so that it slowly comes down and becomes slightly warm during the pro-

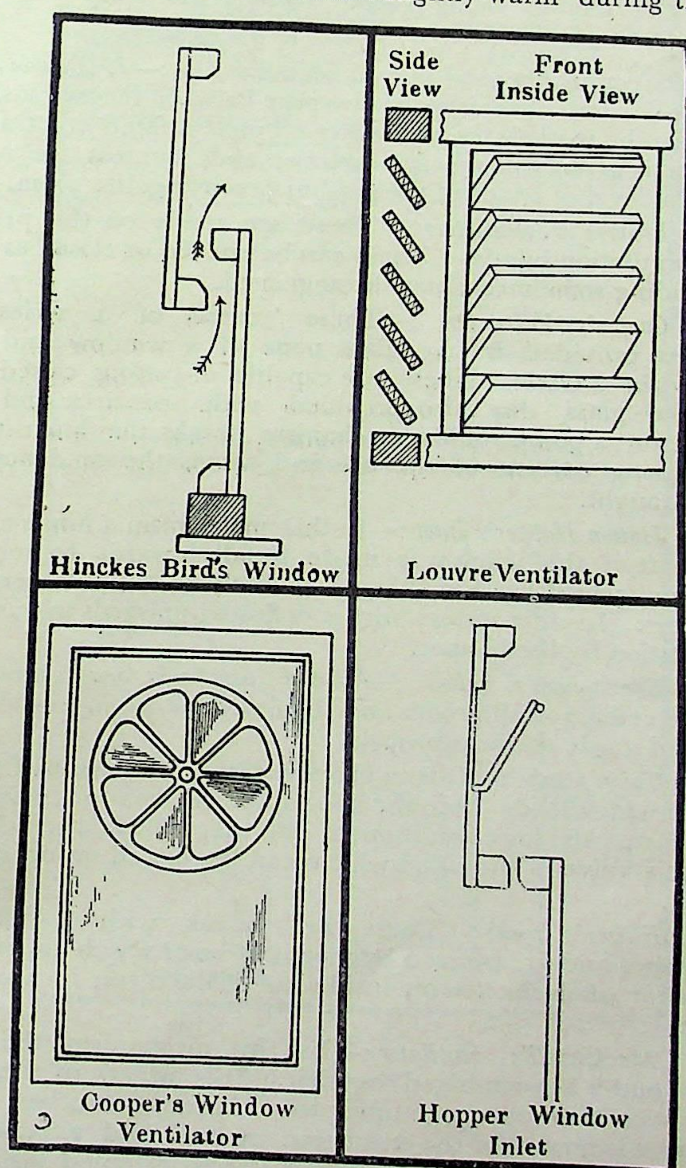


Fig. 13

cess. The object being to prevent cold draught coming to the feet. Whatever devices may be employed as inlets these should

be so arranged that they take in fresh air direct from the outer atmosphere. These should be constructed in a conical design, their wider mouths being placed towards the room and the narrower towards the exterior.

Inlets commonly used in cold countries are :—*1. Double Sash Window* :—It has a provision of air space between the two sashes. Sashes can be worked up and down on pulleys fitted in a frame. The air is given an upward direction and it enters the room above the level of heads of the persons occupying the room.

2. *Louvres or ventilators* :—These are made on the principal of ventilation blinds. These can be opened or closed at will by providing some mechanical arrangement.

3. *Cooper's Ventilators* :—These consist of a series of apertures provided in the glass pane of a window and are arranged in a circle. These are capable of getting closed by a circular glass disc also provided with apertures and are movable on a point. This mechanism breaks the intensity of the entering current of the air and lessens the tendency towards draught.

4. *Hatton Hopper's Inlet* :—In this mechanism a hinge at the upper part of the window is made to fall inwards by moving in a frame, which has side checks to obviate lateral movements of the air. In this system air is deflected upwards in a slanting direction by the hopper.

5. *Sheringham's valves* :—These are windows provided near the ceiling of the room and their wedges project inside the room and guide the air upwards.

6. *Tobin's tube* :—It is a short vertical tube made of metal or wood which leads from the floor upto the wall to a height of 4 to 6 feet. Its lower end opens into the outside air. Inside the tube a valve is provided which can be closed or opened at will.

7. *Ellison's bricks* :—These are bricks with a thickness of 4½ inches and are pierced by means of holes which taper from a diameter of 1½ inches on inside to 1/5th of an inch on the outside.

8. *Mackinnell's ventilator* :—In this mechanism the inlet and the outlet are combined together. It is placed in the roof. It consists of two tubes, one tube placed inside the other. The inner tube is meant for the extraction of foul and vitiated air. The outer tube acts as an inlet. It is well adopted for large buildings such as schools, churches, halls, theatres, etc. which have no upper floors or storeys, preferably in the hot countries.

Outlets :—These are meant for the escape of impure air and should be made of the same size as the inlets. As a general

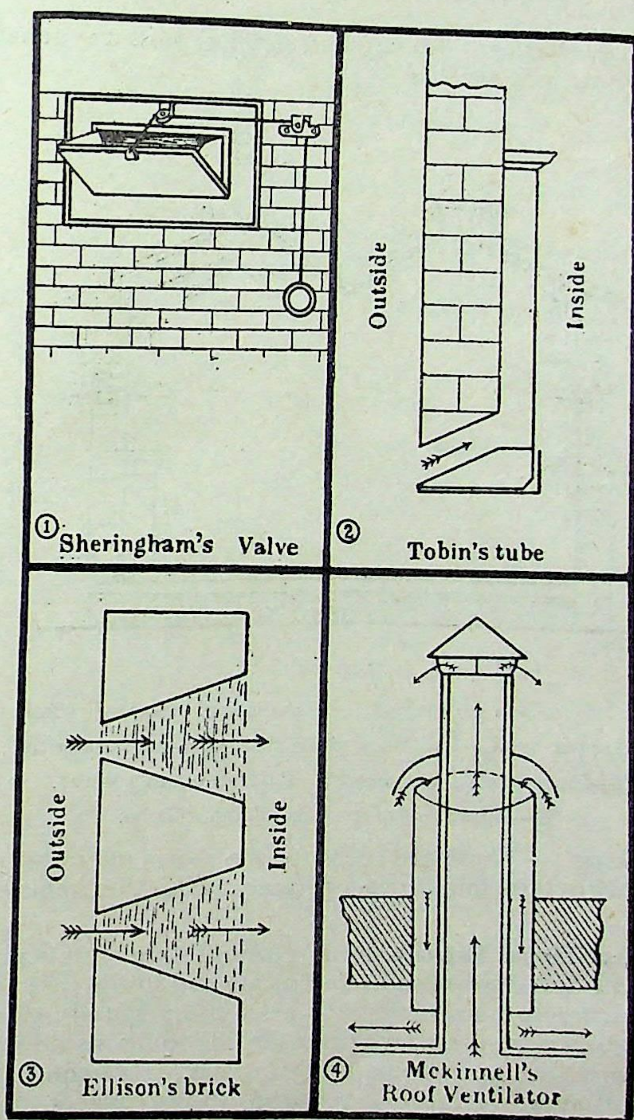


Fig. 14

principle the outlets should be provided opposite to the inlets. These are best provided at the upper part of the room. Rooms with sloping roofs can have outlets in the form of ridge opening along the entire top as in the case of Indian huts.

The various kinds of outlets commonly used are :—

1. *Mackinnell's ventilator.*

2. *Chimney Flue*:—This is the usual outlet for the vitiated air commonly seen in the Indian houses.

3. *Ridge Opening* :—Rooms with sloping roofs are generally provided with such outlets.

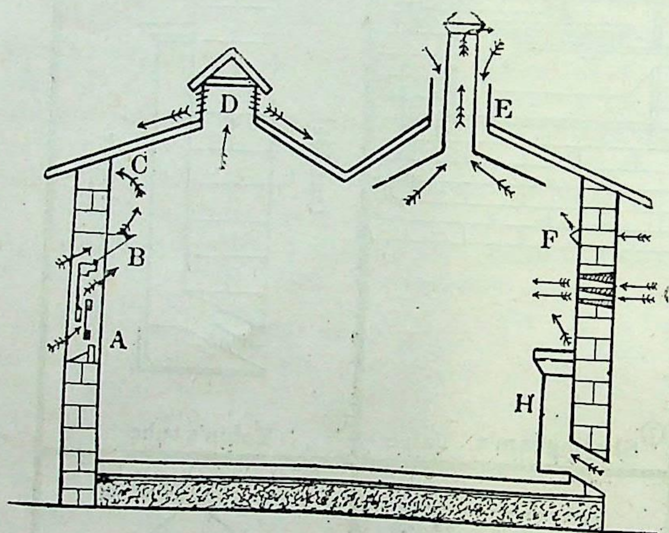


Fig. 15

Sketch of various provisions for ventilation. A—Sash window, B—Hopper inlet, C—Ridge ventilator, D—Louvred outlet, E—Mackinnell's ventilator, F—Sheringam's valve, G—Ellison's brick, H—Tobin's Tube.

4. *Cowls* :—These are seen in the roofs of railways and trams by which the foul air is aspirated while the vehicle is in motion.

B.—Artificial Ventilation: —Natural sources of ventilation are not considered practicable in Europe and in the case of large buildings where a number of people are congregated for a considerably long period and where climatic conditions do not permit free use of open doors and windows. Consequently artificial ventilation is largely resorted to, in places such as theatres, cinemas, examination halls and schools. In this system mechanical means are used to facilitate the renewal of air.

The systems of artificial ventitation are as follows :—

1. Plenum or Propulsion System:—In this system the air is forced into a room by mechanical forces like revolving fans known as blower's steam heated coils, steam jets, etc. Air is forced under pressure and consequently all doors and windows are kept closed. The motor power is installed in a central chamber. The air is washed in a water screen or filtered through a viscous filter, then warmed or cooled, according to the

season and finally humified. It is driven along passages to the inlets of the rooms. The air in this method is introduced at a low level near the floors, so that the breathing line is completely bathed by the incoming air. This method has many advantages :—

(i) The incoming air can be delivered at any level and at any rate.

(ii) It can be warmed in cold weather by passing through pipes.

(iii) It can be cooled and humified by passing through sprays of water.

(iv) Air can be filtered and made free from dust by passing it through the filtering screens of wool.

On the whole it is an excellent method. The great objection for adopting this mechanism, especially in schools, is that the windows have to be kept closed in this system, which is likely to create the bad habit of keeping windows shut, in the students, elsewhere also. This system is however used, to advantage in public halls, factories and printing presses.

2. **Vacuum or Extraction System**:—It consists of the mechanical suction or extraction of the air out of the rooms by means of ducts communicating with the main shaft in which motor power is derived from an electric fan. This method is employed in factories, for the special purpose of providing local exhausts to carry dangerous dusts or fumes away from work rooms or benches. Generally the fans are used for extraction as they can be regulated easily and the amount of their draught can be controlled. Two types of fans are used for this purpose *viz.*, high pressure fans and low pressure fans.

In coal mines ventilation is done by means of furnaces. The vitiated air is exhausted through a chimney. The hot air being lighter and having been reduced in density goes up through the chimney and fresh air rushes in, to take its place.

Apart from the objections common to the artificial methods of ventilation, the main objections to it are :—

(*i*) The extraction of air from all the rooms is not uniform. The rooms situated near the upcast shaft have the air extracted well, but those situated at some distance may have a comparatively little or no extraction at all.

(*ii*) It is very difficult to regulate the incoming air, although suitable inlets are provided, yet air tends to be sucked in through all cracks and holes and may result in the creation of an undesirable draught. Moreover, air from privies, latrines and other undesirable places also gets sucked in.

(*iii*) It is not possible to heat or cool the incoming air. Theatres, publichalls, hospitals and mines are often ventilated on this extraction principle.

3. Balance or Combined System :—This is probably the most satisfactory method. It is a combination of the Plenum and the Vacuum systems. This system is largely used in air conditioning where conditioned air under controlled conditions of temperature and humidity is driven into the room, by means of ducts. Warmed fresh air is delivered at a height of about 7 feet from the floor, by the Plenum method (*i.e.*, a fan is used to force the air in) and all the outlets are connected with an upcast shaft, where extraction is done by means of a fan or a furnace. In England this method is used in the examination hall of the University of Cambridge and also in the House of Commons.

Advantages of Artificial Ventilation :—The air can be warmed, cooled, filtered or humified before allowing it to enter the building. It can be supplied at any rate and at any level inside the room.

Objections to the Artificial Methods of Ventilation are as follows :—

(*i*) These methods are expensive.

(*ii*) These can be rarely adopted to the existing buildings. In order that the methods may prove to be successful, these should be designed as a part of the building at the time of its construction.

(*iii*) The artificial system of ventilation, being expensive, can only be adopted in large buildings on co-operative basis or by persons who are very rich.

(*iv*) These require skilled supervision as where machinery is employed, skilled mechanics are also required.

(*v*) None of the artificial methods of ventilation can ever make the air of a room feel as fresh and invigorating as that by the incoming of a good draught by keeping the doors and windows of the room opened.

Methods of Ventilation Suitable for India :—In India, where the climate on the whole is a settled one, and there being absence of strong winds, natural ventilation will always prove to be the best method.

1. *Ventilation of Dwelling Houses* :—The natural method of ventilation is efficient, cheap and satisfactory. Any of the various inlet and outlet devices may be employed to achieve effective ventilation in the houses. When coal fires become universal in use, Tobin's tubes and chimneys, will have to be provided to serve as inlets and outlets respectively. Under the present conditions the best that can be done to achieve the object is to introduce the free use of windows and to rely upon

some openings provided near the ceiling of the room to serve as outlets.

2. *Ventilation of Schools* :—The class-rooms should be adequately ventilated as air of rooms may become vitiated on account of respiration of students and teachers, by the putrefaction of animal or vegetable matter and the dirt from shoes etc. Besides, there is the danger of germs of communicable diseases located in the respiratory tract of students being added to the exhaled matter. The natural methods of ventilation should be relied upon in the case of school buildings. In planning buildings for the schools, windows and doors should be so arranged, as to provide a crossed draught. The perflation action of the wind can be effectively utilised by opening windows facing the wind. This action is considerably enhanced when windows and doors on the opposite side of the rooms are also kept open. The rooms are thereby rapidly and continuously flushed with fresh air and it becomes feasible to renew the air of a room at the rate of 100 times an hour. Such a method is of unquestionable utility for rapidly changing the air of an unoccupied class room and may generally be put in operation. In inhabited rooms during the summer season, when the temperature inside and outside the house approximates, Sheringham's valves or Tobin's tubes may also be employed. School ventilation should be further assisted by adopting administrative measures also. No lesson should be continued more than an hour and an interval of 10 to 15 minutes should elapse between two consecutive lessons. During this period the class room should be kept empty. The outgoing teacher should be held responsible for ascertaining that all windows and doors of the class room are flung open as soon as it is vacated. The incoming teacher may close as many windows of the class room as he considers necessary, depending upon the prevailing weather conditions and the temperature. This gives the room a flush of pure air for about 10-15 minutes.

3. *Public Buildings* :—Natural methods of ventilation are rarely considered satisfactory for public buildings where people are congregated for considerably, long periods *e.g.* theatres lecture rooms and examination halls. In such cases adoption of artificial methods of ventilation are considered as desirable.

Efficiency of Ventilation of an Inhabited Room :—The following points should be kept in view :—1. Make the visit at the time of maximum contamination *e.g.* in a sleeping room, just before the person rises. Note the "*Sense impression.*"

2. Calculate the cubic space of the room, by the following formula :—

Length × breadth × height = Cubic area

Deduct the cubic space occupied by solid articles in the room such as big trunks, solid furniture, etc.

3. Ascertain the number of occupants of the room. The total amount of cubic feet of air per hour supplied can be calculated thus :—

Number of accupants × allowance of cubic feet of air per hour per head.

4. Floor space per head is ascertained.

5. The rate of velocity of air can be ascertained by means of an anemometer.

6. The inlet provision for fresh air is considered as 24 square inches for each person. The direction of air currents must be determined, which can be conveniently done by examining the situation of inlets and outlets of the room. These can be distinguished by observing the direction of smoke emanating from smouldering brown paper.

7. Efficiency of proper ventilation can be tested, by smell test or by Pattenkoffer's test (*i.e.* lime or baryta water test). Estimate the percentage of CO_2 in air.

8. Find out the number of artificial lights used in the room and the amount of fresh air required for these per hour.

9. The number of bacteria, or dust particles in a room may be estimated by a Slit Sampler.

Vital Capacity—This is known as the 'respiratory capacity' or 'extreme differential capacity" and denotes the maximum volume of air that can be expired after maximum inspiration. It usually ranges from 3000 to 5000 c.c. but the amount varies according to age, height and vigour of the person concerned.

Airborne Epidemies—Infections spread through air either from inhalation of dust or by droplet infection and the main diseases produced therefrom are tuberculosis and pulmonary form of anthrax. Due to inhalation of particles of dust in various factories, it may give rise to silicosis, siderosis, anthracosis, etc. Smallpox, mumps, measles, diphtheria, scarlet fever and some virus diseases are also air-borne.

HEATING OF ROOMS

This is commonly done by the combustion of some sort of fuel, and the heat produced thereby is distributed by the following methods :—1. *Conduction* :—As a general principle solids are good conductors of heat, while liquids and gases are bad ones. Good conductors rapidly transmit heat to the surrounding air and to the articles they come into contact with.

2. *Radiation* :—By this process heat is transmitted through air in straight lines on all sides with equal intensity.

3. *Convection* :—In this case heat is transmitted through gases and liquids.

The common methods of heating houses or buildings are :—

(a) *Open fire places* :—Where wood, charcoal or coal is used. This method is extremely popular.

Coal yields a good deal of smoke and is a serious cause of atmospheric pollution. Coke and anthracite are more solid and smokeless. The advantage of open fire places is that they are cheerful in appearance and forms a useful attraction for the family. The disadvantage is the heating of the room is unequal; most of the heat falls on that objects nearest the fire. The heat is uneven as the fire burns, alternately bright and dies down and needs replenishing of the fuel.

(b) *Closed fires or stoves* :—These stoves are made of cast iron in which coal, coke, paraffin, etc. are used as fuel. They give a more uniform heat because they heat by convection. The disadvantages are that they are less cheerful and not as efficient for ventilation as open fires. They dry the air.

(c) *Heating by hot air, hot water and steam* :—These methods are not commonly used in India. In case of hot air, mechanical methods are used to heat the air, which is used for warming the buildings. When hot water or steam is used, it is circulated from a central source to the various parts of the buildings and is called central heating.

(d) *Electric Fires or Radiators* :—heat by radiation. They have advantage of being clean, easily regulated and do not give off any impurities ; but if used continuously, are more expensive form of heating than modern solid fuel fires. Their one disadvantage is that they dry the air.

(e) *Panel heating* :—In this system heating units are embedded during construction of the building in the floors, ceiling and walls. This method is generally used in schools, hospitals and other public places.

ARTIFICIAL COOLING

It has been found that artificial cooling in tropical countries like India is not a luxury but an absolute necessity. It applies more particularly to certain industrial processes where an improved product and higher rate of production are obtained if atmospheric conditions are controlled to suit the process. The workers work under more comfortable conditions and so their efficiency and output is increased. It has also been adopted in several hospitals particularly in operation theatres, restaurants, cinema halls, etc. This is done by the following methods :—

(1) Closing doors and windows during day time and fixing blue cloth over glass panes.

(2) Fans and Pankhas.

(3) Khus-Khus tatties or chicks :—These are used as a screen during summers. They are kept continuously saturated with water. The dry air of the atmosphere causes evaporation and the heat of the room is absorbed and thus it keeps the room cool. This process is all right for Northern India where the air is hot and dry but it is not suitable for places like Bombay, Calcutta, Madras etc. where the climate is hot and moist. It will reduce the temperature but will increase the relative humidity and thus will increase discomfort.

(4) Supplying cold air from outside.

(5) Refrigeration, condensation and rarefaction.

Air Conditioning:—During summer season discomfort and inconvenience is experienced due to high temperature and humidity so in air conditioning, reduction of both temperature and humidity is considered necessary. In addition, it is necessary to control the purity and movement of the air.

Comfort Zone :—In tropical countries after adequate air conditioning, the air of a room should have a temperature of about 70°—72°F and relative humidity 60%. This varies due to certain factors such as the individual, the nature of the clothes he is wearing and his state of health. One who is well-dressed and fat may feel hot, while a poorly dressed slim person may feel cold.

The problems of air cooling in the tropics differ in principle according to the local conditions of weather and climate. In Northern India the air in hot weather is excessively hot over 100°F, but is dry ; a reduction in temperature alone will give comfort, even if accompanied by a rise in relative humidity. In hot moist elimates, on seaports like Calcutta, Bombay and Madras discomfort is experienced both by high temperature and high humidity. Reduction in both temperature and humidity is therefore necessary.

Principle :—The hot air drawn through a layer of fine water jets and while passing through it, evaporates the water and thereby becomes cooler due to the loss of heat absorbed by water during its process of evaporation. The cool air in this process gets saturated with moisture and excess of moisture is subsequently removed by passing it over or through a cold surface. The air is taken and delivered into the rooms through ducts. During its passage through the ducts, it gets warmed on account of absorption of heat from the air of the room or the hall by means of outlets, which lead it back to the cooling machine where it can be cooled again.

Air-conditioned room :—In the construction of the wall, some

hollow spaces are left to admit the conditioned air and to take the same back, after having been into the room.

Several types of plants are in the market, though they work on the same principle.

LIGHTING

The lighting of building may be natural or artificial.

Natural light should be used where possible both for economy and for its beneficial effect on health. It is obtained by windows which should have an area of atleast one tenth of floor space. The rays of sun include light rays, heat-rays and invisible ultra voilet rays.

Artificial lighting should provide adequacy, consistency and uniformity of illumination without flickering or glare and an absence of shadows. Light may be produced by the combustion of substances which burn with a flame or by electric current. All forms of artificial light, heat a room and all with the exception of electric light, vitiate when artificial light is being used. More ventilation is therefore required when artificial light is being used. The commonest form of artificial lights are as follows :—

1. **Candles** :—These are most ancient form of lighting. They give a very soft and poor light with a certain amount of flicker. They are portable and useful in emergencies, but a source of danger as their flame is naked. The standard candles weigh one sixth of a pound, burning 120 grains of wax per hour. The electric unit - the Watt - is being equivalent to 0·8 candle power.

2. **Paraffin Lamps**:—They are used in houses where there is no electricity. They involve a great deal of labour in cleaning, trimming and filling the lamps. They have the disadvantage of blackening the walls or ceilings and giving slight smell of petroleum. The metal burner is well perforated to allow admixture of air with the paraffin vapour, to ensure a good combustion. The flame is shielded by a chimney.

3. **Gas Lighting** :—Coal gas used to be burnt on a fishtail burner but now the light is obtained by heating an incandescent burner with the lighted gas. If there is not enough oxygen for complete combustion of coal gas, carbon monoxide may be formed and this gas is highly dangerous. Moreover the great danger of coal gas is the risk of its escape, causing explosions or death from carbon monoxide poisoning.

4. **Electric Lighting** :—It does not involve combustion and therefore no oxygen is taken from the air and no waste substances are produced. It resembles solar light that it contains violet and ultraviolet rays and it produces very little

heat. Fluorescent electric lighting is advocated for certain purposes where a steady light, with a minimum of shadow is required.

Ill Effects of Bad Lighting :—The most common are:— Eye strain, headache, tendency of postural deformity such as wry neck, round shoulders, poking head and lateral deviation of spine. Irritability of temper, great liability to accidents, slovenly habits and lack of tidiness and order. The quality of work as well as the quantity suffers.

School Lighting :—This must be satisfactory because the continued strain of trying to see in an inadequate light is especially harmful to young children. The light should enter, if possible over the left shoulder of the student and there should be an absence of glare from the blackboard and from the school books.

Artificial Lighting of Workshops and Factories:—It has been found in industry that inadequate lighting is uneconomical, as the output tends to fall and there is increased accident rate. If lighting is below a certain level, the workers complain of discomfort and eye-strain. Poor lighting in coal mines is an important cause of miner's nystagmus.

The illumination should be good as well as adequate. It should be constant and uniform. There should be no flicker or other variation; glare should be avoided and bright light shadows eliminated. No worker should be permitted to gaze directly or at a bright light and every means should be taken to see that glaring light does not enter the eye even obliquely. Shadowless lighting is essential for certain types of fine work. Windows should be kept clean.

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CHAPTER III

DISPOSAL OF REFUSE

In every town public health largely depends on the efficiency with which all waste products are collected, removed, and disposed.

The waste-products which require removal from human habitation are :—1. Excretal refuse *i.e.*, faeces and urine.*

2. Wastewater from houses, works and manufacturies.

3. Refuse : (*a*) Dry refuse from houses, such as ashes, house dust, cinders, pieces of wood, iron, etc.
(*b*) Solid and liquid refuse from stables, cowsheds, slaughter-houses etc.
(*c*) Street sweepings, such as rags, horse and cowdung, etc.
(*d*) Garbage, leaves, vegetables, rotten fruits etc.

4. Dead animals.

Scavenging :—It means the collection and the removal of the town and domestic refuse and other wastematerial, which is not carried away by sewers. This is done by manual labour.

Conservancy System :—This means collection and removal of human excreta from privies, dry closets, latrines, etc., by manual labour.

Household and Street Refuse :—This includes dry refuse from houses, streets and roads. It comprises mineral matter from sweepings, ashes, organic matters, waste scrapings of wood, paper and garden refuse, mainly consisting of leaves and other vegetable matter.

Trade Refuse :—It consists of refuse from any of the manufacturing trades or business concerns.

Consequences of Incomplete Removal of House and Street Sweepings are :—1. The contamination of the soil and pollution of subsoil water from which drinking water is derived.
2. Fly breeding.
3. Dissemination of filth diseases.
4. Dogs, birds, cattle etc., will scatter the refuse and increase nuisance.

Collection, Removal and Disposal of Refuse :—It consists mainly of household, stable, cattle shed and street refuse.

*In the case of adult Europeans it amounts to about 4 ozs. of solid and 50 ozs. of fluid each day. While an Indian, owing to his vegetarian diet passes 8-10 ozs. or more, on average 12 ozs. of solid excreta. In India water is used instead of paper and this ablution water together with liquid excreta is about 80 ozs.

The nature of refuse depends upon the habits of the population.

(*a*) *Household Refuse* :—**Collection** : The standard method is to put all domestic refuse into galvanised iron cans or tin tubs provided with handles and well-fitting lids the object of which is to prevent blowing away of refuse by wind and to keep out the rain water, as on account of the organic matter contained therein, the domestic refuse will ferment and putrefy thus producing a bad smell, which action is hastened by the presence of moisture. It may also provide food for rats, vermin etc. The lid of the tub also prevents flies from getting in and breeding in the refuse. It should be provided with a rim at the base so as to raise the bottom of the bin from the ground just to prevent its rotting due to dampness of the ground. A still further improvement is to place the bin on a stand made of two crossed pieces of wood and a top. These dust bins or tin tubs should have handles on each side and should be of such sizes as can be handled easily by the conservancy staff. Moreover, these should be suitably placed so that they can be reached conveniently by the conservancy staff without causing annoyance to the inhabitants. These should be emptied out daily, once in winter and twice in the hot weather, in countries like India.

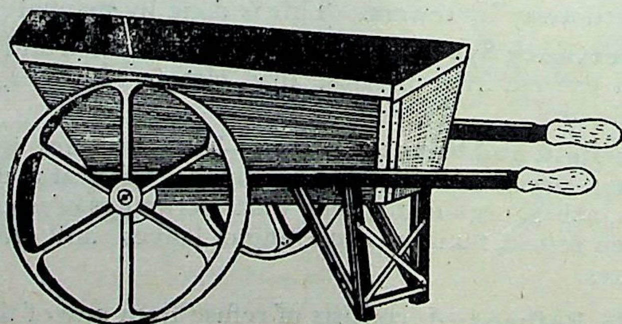


Fig. 16—Double wheel barrow

Removal :—The refuse should be collected in properly covered, hand carts & refuse carts, provided with closed lids to prevent the refuse from being blown out by air.

(*b*) *Special Refuse* (*i.e. from stables, cattle sheds, etc.*) :—It consists of grass, straw mixed with dung and moistened with urine. It ferments rapidly giving rise to objectionable smell. The more it is disturbed the more it emits smell. The method adopted for its removal in England is that on iron conservancy cart is kept in the proximity, *i.e.*, in the premises and this refuse is at once packed into the cart which is removed at frequent intervals as and when required and an empty one left in its place. Such carts can also be made in this country.

(c) *Street Refuse* :—It consists of droppings of animals, horses, and other cattle together with mineral matter swept along with street sweepings. In the towns of England, this is collected by conservancy staff from the streets and placed in dustbins suitably placed along the street. In India, dustbins made with corrugated iron should be placed on raised concrete platforms, away from the dwelling houses. They should be of standard size and provided with handles for lifting. The street sweepings should be collected in these dustbins.

Removal :—This is done in the Punjab through different agencies such as bullockcarts, donkeys, etc. In good municipalities covered carts are used for this purpose. They are also being gradually replaced by trucks and tippers fitted with mechanical means of tilting for quick and speedy removal of the refuse, as is done in England and other Western countries. The refuse should be removed daily both morning and evening. In England conservancy staff removes it at night, so that they may not be of any nuisance to the residents of that locality.

Disposal of Refuse : —The refuse after collection should be disposed of in such a way that it does not create any nuisance. There are 4 ways for its disposal :—

1. *Incineration* :—It is one of the best methods of disposal of refuse. It is rendered harmless by burning and the refuse is reduced to one fourth of its original weight. The organic matter is transformed into carbon dioxide and nitrogen. The residue left behind after the burning off the refuse is a mass of hard material called 'clinkers'. This is usually utilised for road making, after getting it thoroughly powdered and mixed with lime. The mixture thus produced has a great cementing action. An incinerator or the Destructor Furnace consists essentially of the following parts :—

(i) A furnace or a combustion chamber, built of fire proof bricks with cement linings.
(ii) A suitable arrangement with a platform for tipping the refuse through a series of feeding holes through which the rufuse falls into the cells below.
(iii) The stokers for raking the refuse forward to the fire.
(iv) A baffle plate so placed that all fumes are driven through the hottest part of the incinerator or combustion chamber, before passing up through the chimney.

Various patterns of incinerators *viz*., double cell Meldrum and single cell Horsefall destructors are available in the market. They all work on the same principle.

The chief advantages of incineration are that the cost of carting is minimised to a very large extent. It is reduced to one fourth of its original volume and residual ash, or the clinker can

be used for making roads, mortar, cement or filter beds. The only disadvantage is that the refuse in the incinerators does not burn properly during rains due to too much moisture contained in it. The chimney of the incinerator should be sufficiently tall and the draught of the air should be adequate for efficient combustion, failing which the incinerator will give off offensive smoke which will obviously create nuisance.

2. *Dumping* :—In this method the refuse is generally utilised in filling up empty pits or hollows, insanitary tanks or in reclaiming lowlying tanks. When these are filled up by the refuse, the ground is called "madesoil". It creates a great nuisance to the neighbourhood on account of the production of offensive gases, breeding of flies, harbouring of rats and other vermin. The land selected should be situated outside the limits of the town *i.e.* 100–150 feet away from the nearest habitation, as accumulation of filth is liable to pollute the water supply of the area.

If dumping is done under proper supervision and during dry season, it is called "controlled dumping." In this method the work of filling up should be started from one end and gradually pushed on to the other end. Refuse material should be deposited in layers but not in any case exceeding six feet in depth and should be covered with about 9 inches thick layer of earth. No refuse should be left uncovered for more than 72 hours. Each layer of refuse along with the layer of earth lying over it should be allowed to settle, before the next layer is deposited upon it. Filling should be done 2 feet above the level of the surrounding area to allow subsequent settlement. When the work of filling is completed, cultivation should be done for about 10 years before the site is used for construction of residential houses.

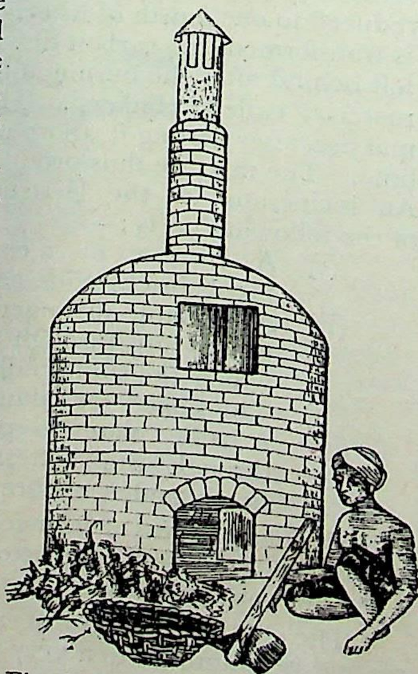


Fig. 17—An ordinary incinerator

3. *Compost Formation* :—This method is used mainly in the towns where refuse has to be disposed off with night soil and its main object is to convert the waste matter into humus or compost of high manurial value.

4. *Sorting* :—This method consists of sorting the refuse into 3 parts :—

(*a*) *Breeze* :—It consists of cin-

der and small particles of coal. It is used in brick making.

(*b*) *Soft Core* :—It consists of animal and vegetable organic matter. It is used as a manure.

(*c*) *Hard Core* :—It consists of broken bottles, crockery and tiles. It is utilised for metalling roads.

Collection, Removal and Disposal of Human Excreta :—For this purpose the following systems are adopted :—

1. Conservancy System.
2. Water Carriage System.

CONSERVANCY SYSTEM

In this system the excreta has to be collected and removed by manual labour. This method is universally adopted throughout the East and was at one time adopted throughout the world, but in Europe and in some large cities in India, it has now been replaced by water carriage system. It is, however, still in vogue in Europe at least for small communities which are unable to meet the high cost of water carriage system.

The efficient working of this system is of great importance. The principle aimed at is that filth, refuse and all other putrescible matters should not be exposed to flies or allowed to contaminate the sources of water and should be transported and disposed of, safely without causing, even the least possible nuisance.

1. Privy System :—The privy is meant for private use. It is simply a place where excreta is deposited until removed. It should be situated on the ground floor of a house, at a distance of about six feet from a living room and about 40 feet from the nearest well or any other source of water supply.

It should consist of a brick built and cement lined chamber and should be of a small size and provided with a proper seat. The object of cement lining is to make it water froof, so that the contents should not permeate the ground and contaminate the underground water. It should be well ventilated and have a provision for an adequate supply of air and an external wall to permit light and ventilation. It should be protected from flies by providing wiregauze to the windows and doors so that they may not be a source of spreading infection of disease germs as of dysentery, typhoid, cholera, etc.

Privy system is most objectionable as it gives rise to nuisance of smell especially when it is cleaned out and there is a danger of fly breeding also. This privy system is the simplest, but at the same time most insanitary of all systems. Besides, there is likelihood of leakage and thus contaminating the soil and subsoil water.

2. Pail System:—This is an improvement over privy system. Here a pail or any other removable receptacle is placed

underneath the seat which is removed as soon as possible after the use of the privy, and immediately after that emptied out by the sweeper in a storage pail provided with a well fitting lid, and is cleaned and kept ready for reuse. In Indian houses, this removable receptacle is commonly made of iron sheet and sometimes earthen-ware '*gummalas*' are also used for this purpose. Various shapes of these receptacles are used. Sometimes two such receptacles, by keeping one in front of the other, are used in each compartment for collecting urine and faeces separately. This is done when urine and faeces are to be disposed off separately. This separate system has many advantages. If the liquid and solid matters are collected in separate receptacles the process of decomposition is slow. Consequently the latrines become comparatively less offensive. This system also prevents the possibility of splashing to a large extent, and over flowing of receptacles which generally happens when the latrine is used by a large family.

3. The Commode :—Its use is very common in Europeans and rich families in India, particularly at places where there is no adequate water carriage system. It consists essentially of a hinged wooden seat provided with a big circular hole in its centre under which a removable enamelled iron, porcelain or iron receptacle is placed. The pail from the commode is removed by the sweeper immediately after use. It is taken off by him in a basket to the place of secondary collection. Here the contents of the pail are emptied out into a large collecting drum. The pail is cleaned and refitted to the wooden seat. In most houses some suitable disinfectant is also supplied to the sweeper for scrupulous cleaning of the pail.

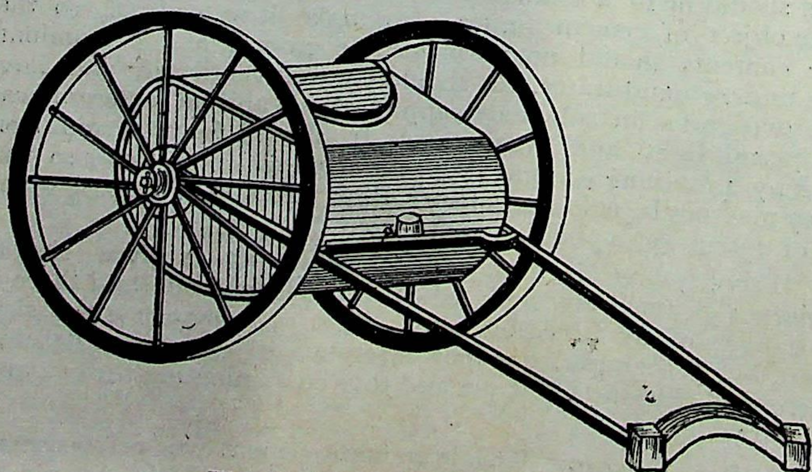


Fig. 18—Night soil or Crawley Cart.

From the secondary collecting drum the night-soil is removed by the conservancy staff by either of the following ways :—

(*i*) The collecting drum is emptied into a crawley cart, which consists of an iron tank, mounted on wheels and drawn by bullocks.

(*ii*) The collecting drum is removed in a cart and another drum left in its place.

4. Earth Closet :—This is an improvement over the pail system to the extent that mechanical arrangements are provided for depositing a large quantity of earth into the pail after use. The earth acts as a deoderant, prevents the emittance of foul smell, and well mixed with faeces, ensures complete disintegration in a short time.

5. The Well or Pit Latrine :—A pit or a welllike hole 10-20 feet deep is dug in the ground. At the top of it a masonary platform, having a provision of a seat and a superstructure, is built. In such a privy the septic tank action goes on and the nightsoil is liquified. This system is objectionable from sanitary point of view as not only foul gases are evolved but there is a risk of pollution of water supply of the surrounding area through soakage, especially after a rise in the level of subsoil water during rainy season.

6. Boredhole Latrine :—This is a modification of a well privy. It consists of a circular hole of 14-16 inches in diameter sunk 18-20 feet deep or under the ground until the surface of subsoil water is reached. The opening of the hole is covered at the top with a concrete slab of about 2 feet 9 inches in diameter for squatting purposes. It is provided with a central slot 5½″ wide and 12″ to 15″ long and is fitted with footrests on either side. The whole structure is enclosed with mud or a brick wall about 5 or 6 feet high for screening purposes.

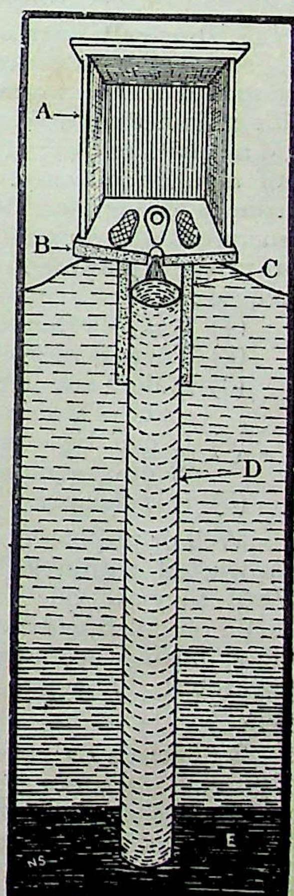


Fig. 19
Boredhole latrine
A—Superstructure
B—Squatting plate
C—Concrete cylinder
D—Bamboo basket
E—Water.

Care should however, be taken that the hole penetrates about 2-3 feet below the surface left out of subsoil water,

which helps to dissolve the excreta and in setting up septic tank action. This dilution of excreta with water is very essential.

A lining of split-up bamboo is put inside the wall of the latrine hole, to prevent the earth from collapsing or falling in. That is why it is essential that the latrine should be sunk in a hard soil. These latrines have been much used during anti-hookworm campaigns launched in different countries.

A small quantity of pestrine should be sprinkled or a solution of crude oil 4 parts and kerosene oil one part sprayed into the hole of the latrine once a week to keep away flies.

7. Dugwell Latrine:—It is another form of a well privy is commonly advocated in rural areas for preventing which the spread of hookworm infection. It consists of a pit 15 feet deep with a diameter of 3 feet. It is provided with ½ inch water seal and a squatting plate of 3½ feet diameter. It can be flushed with half a gallon of water. Septic tank action takes place. One latrine is enough for 3 years, for a family of 5 persons. A superstructure made of mud bricks and bamboo matting is provided for privacy purposes. It is better than boredhole latrine because :—

(1) It is free from fly breeding.
(2) There is no pollution of subsoil water.
(3) It does not give out offensive gases and smell due to presence of waterseal.
(4) It can be constructed with a spade. No special implement is required, as, say, an augar for a bored-hole latrine.
(5) It is cheaper.

Well or pit, bored hole and dugwell latrines should not be constructed within 50-100 ft. from any source of water supply. When they are filled up to 2½ ft. from the ground level, they should be filled with earth and new ones should be constructed. These latrines are useful for small villages, isolated houses and teagardens. They are cheap and if properly constructed, last long.

8. Trench Latrines, Shallow Type:—These consist of rows of parallel trenches. The trenches are 3 feet long, one foot wide and 1 to 2 feet deep and are dug at a distance of two feet away from each other. These may be provided with privacy screens. The faeces, urine, and ablution water fall directly into the trench. The trench should be filled up by the excavated earth, after use. Trenches are suitable as a temporary measure during fairs in rural area.

9. Trench Latrines, Deep Type :—Each trench should be about 3 ft. deep and of a suitable length, usually 13 ft. The sides should be rivetted with sandbags, wirenetting or bamboo matting to prevent collapsing. A fly proof wooden superstructure

with a hinged lid opening is placed in position over the top. The seats are properly screened. The person using the trench latrine should place one foot on each side of the trench. He should squat in such a way that the faeces and urine fall directly into the trench.

10. Chemical Closet:—This consists of a seat resting on the top of a tank which is filled with a solution of caustic soda and phenol and covered with a layer of crude oil. The excreta falls into this solution, which gets disintegrated in soda solution. Phenol kills bacteria and the oil acts as a deoderant. When the tanks get filled up, they are emptied and the contents are either taken out and thrown or discharged into a dump hole. Chemical closets are of two types :—

(a) *Portable chemical closet* :—It occupies comparatively little space and is therefore very suitable for use in motor coaches, small ships, aircrafts etc. It can also be installed in houses where there is no water carriage system. It is in the form of a pail closet where receptacle is placed inside a portable metal container. Chemicals in the form of an emulsion are placed inside the pail which completely cover the excreta. It subsequently deoderizes, liquifies and sterilizes, rendering the excreta harmless, which is afterwards disposed off into the earth through a simple soakage pit.

(b) *Permanent chemical closet* :—In the case of permanent camps, sports grounds and country houses where there is no water carriage system, permanent chemical closets are installed. It differs from the portable type that excreta instead of collected into a movable pail falls into a tank which is permanently installed.

11. Aqua Privy :—It is a miniature septic tank consisting of a masonary tank or a watertank reservoir of an approximate size 3 ft × 2½ ft. provided with a 2½ ft. long tube merged into the tank. A platform and a seat is provided on the top. The effluent is allowed to percolate into the soil or taken out in a receptacle and used for irrigation purposes. Water is to be added every time during and after its use and the ventilation tube is to be kept open to provide exit for the foul gases.

12. Public Latrines :—These are meant for public use. These may be constructed temporary or permanent as the need be. The temporary ones are generally used in fairs, *melas*, camps, etc., commonly in dry parts of India. The receptacle for nightsoil is placed on the ground and the latrines are provided with masonary footrests. These require no plinth or roof. They have corrugated iron sheet partitions. The site should be high and there is no other masonary construction. The permanent

latrines should never be located within a distance of 20 ft. from any dwelling house, public road or within a distance of 50 feet from any source of water supply.

Construction :—The floor should be cemented or made with any other impervious material so as to be water proof. It should be properly sloped backward upto an open channel leading to a collecting pit dug at one of the corners of the latrine. In the pit a removable bucket is placed and connected to a delivery pipe to catch the surface drainage of the latrine. It should be roofed over to provide shelter from sun and rain and be provided with privacy screens. These privacy screens should stop short about one foot from the cemented floor all around to allow free ventilation. The roof should be sloped or curved to facilitate the draining of rain water. The walls may be either of brick work or corrugated iron. They should preferably be pigeonholed towards the upper half for proper ventilation, or else provided with ventilators. The seats should be arranged in a row. A flap door is provided at the back for removal of the bucket by the sweeper. The standard type seat of latrine is simply an elevated platform of galvanized iron with foot rests, a central hole and under the hole a bucket, a pail or a *kunali* is placed. It must be longer than the size of the hole, so as to obviate the possibility of excreta missing the bucket. The seat must be kept clean and occasionally coal-tarred to prevent the ammoniacal fermentation from decomposition of the urine. Foot rests must be made in the right position and they should not be unduly wide apart so that the faeces may fall direct into the receptacle below. In order to prevent splashing, the receptacle should be placed directly below the opening at a distance of about 2-3 feet although in some cases this distance may be even more. In order that a latrine be kept clean a sweeper must

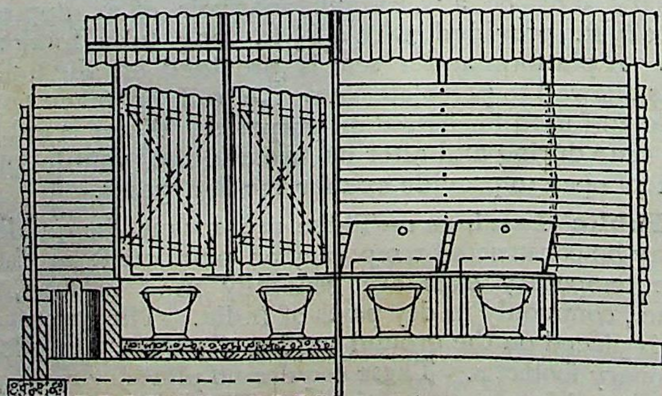


Fig. 20—Public latrine four seated (half section & elevation).

be constantly present, especially during the time when latrine remains much in use. The duty of the sweeper should be to empty the pail into the collecting drum and after cleaning the pail to keep it back at its place. There must be dry earth stored near the latrine which should be sprinkled in the pail in order to avoid the excreta adhering it. If pails are not kept clean, they will emit foul smell due to the decomposition of urine, etc., Similarly if the surface drainage is not attended to, there will be a constant nuisance from smell and it will provide a breeding place for the flies, but if proper lids are provided on the drains, these dangers will get considerably minimised. The storage or collecting drums are either removed in a cart or their contents emptied out into a crawley cart.

It is said that these latrines are not much used as the public has a dislike for them, because they are allowed to remain uncleaned for hours and even days together. Two sweepers are required to adequately look after the cleanliness of each set of latrines if they are to be kept constantly clean, whereas, if left otherwise, being unclean, they will not be much used by the public

Removal of Nightsoil :—The collection of nightsoil is done by manual labour by the sweepers who empty the privy pans into collecting drums provided with lids, which are carried direct to the place of disposal or their contents transferred into the nightsoil carts at the depots. The pail depots or transfer-stations should be situated at a sufficient distance from human habitation.

The collection of nightsoil should be done in the early hours of the morning and if possible, once again in the afternoon. Urine and washwater should also be removed in the nightsoil carts for disposal thereof at a far off place.

Disposal of Nightsoil :—This can be done by any of the following methods in conservancy system :—

I—Trenching :—This is a standard method which is compulsorily adopted in all the cantonments and military stations in India, but this system is not very much resorted to by most of the municipalities probably because it does not bring any money and a difficulty is experienced by the authorities in procuring land near the towns, for this particular purpose.

Selection of Site for Trenches :—The ground for the trenches should be selected at a convenient distance from the town and should not be too close to it. The ground should be at a higher level because the low lying land is liable to be encroached upon by floods during rainy season or may become water logged. It should be loamy and alluvial but should not be sandy. It should not be situated in the neighbourhood of a source of watersupply

but should be at least 300 yards away from it. Moreover it should be about 600 yards away from all human habitation. The ground, should be situated on one side of the town away from the prevailing winds and should be separated from the town by means of some rapidly growing trees. The approach to the trenching grounds, should be easy and accessible, preferably by a coal tarred road.

Preparation of Trenching ground :—The selected area is levelled and drained and is then divided into 12 parts, thus earmarking one part for each month of the year. It should be intersected with properly planned metal roads to be used for the carts. The plot which is once trenched should not be used again for making trenches for at least two years.

Emphasis should be laid on the following points in the management of an ideal trenching ground :—

1. There should be an adequate arrangement for the systematic drainage of rain water.

2. There should be a provision for one or two roads for the carts to reach right up to the trenches.

3. Some source of water supply should be made available in the neighbourhood of the trenching ground to facilitate the washing of carts and buckets.

4. The excreta after filling into the trenches should be immediately covered with earth to prevent the breeding of flies.

5. The carts and other appliances should be cleaned periodically with liquid disinfectants like crude oil.

6. Cultivation should not be allowed at least for 3 months after the trenching. It is preferable that dhoop grass be cultivated first.

Kinds of Trenches :—1. *Shallow* :—These are dug 2 feet wide and 9 inches deep. In these trenches a 2 inches thick layer of filth is spread, the bottom of the trenches having been loosened. It is then covered with earth.

2. *Deep*:—These are also 2 feet wide but are from 12 inches to 18 inches in depth. These should be situated 2 feet apart from each other. In these trenches 8 inches thick layer of filth can be spread and then covered with excavated earth.

3. *Allahabad System of Trenching* :—This is really the shallow trench system and is used in cantonments. Each trench is 16 feet long ond 5 feet broad but it is only 3 inches deep. The base of the trench is dug up and the soil loosened to the depth of 9 inches. The filth is then put into the trench and thoroughly mixed up with the loosened earth. The trench is finally filled up with earth.

Area of Ground Required :—In shallow trenching system 180 square feet of the area of the ground per day is required for a population of 1000. This area includes the trenches as well as the ground between them used for making roads, etc. 1½ acres of land is required for making such type of trenches to cope up with requirements of a population of 1000 for full one year.

In deep trenching system one fourth of the above area is required or about one third area of land per year per 1000 population. This calculation will permit trenches being left undisturbed for a year.

Filling of Trenches :—These are laid out in a line and the nightsoil is poured down into them from the storage pails or crawleycarts by hand labour. These are filled up with earth dug out from them so that they appear like elevated mounds and prevent pits being formed when the earth settles down subsequently.

Cultivation of the Trenchinggrounds :—Three months after the filling up of the trenches, the ground should be ploughed and sown with any suitable crop. Practically any crop will grow but the general rule adopted is, that the vegetables usually eaten uncooked should not be grown. In the Punjab, tobacco, sugar cane, lucerngrass, etc., are usually sown. The objection to growing vegetables is based upon the assumption that they may pick up infection from the soil. It has also been stated that the eggs of intestinal parasties, *i.e.*, worms may be carried by vegetables grown in the trenching grounds. In very dry climate, the trenching ground should be irrigated to prevent soil becoming dry and hard. Moreover, deep trenches should always be employed, otherwise the wind may blow away the surface and expose the trenches to flybreeding. This is the main objection put to the Allahabad system of trenching. The ordinary house fly, quickly lays its eggs on human excreta and if the trench happens to be superficial, then the hatching larvae will have no difficulty in developing into adults which would be congenitally infected with pathogenic germs, *i.e.*, typhoid etc., and may retain the germs for some time in their bodies. Shallow trenching is preferable because deep trenching requires very deep ploughing to yield manurial value of filth.

In very wet countries, it is not possible to carry out trenching system during the rainy season. In such cases, the only plan to overcome this difficulty is to have large elevated cesspits built on the trenching ground, where filth can be stored until the rainy season is over and then it can be disposed off subsequently by trenching in the usual way.

Object of Trenching :—Soil is a great bacteriological laboratory and the bacteria present in the soil very rapidly break up the

organic constituents of the nightsoil into simple non-putrefiable compounds which are used up by the plants in the process of metabolism. Various gases are given off in this process but these are absorbed by the pores of the earth and so once the filth has been buried underground, it gets satisfactorily and economically disposed off without causing any nuisance owing to its foul smell. Experiments reveal that the soil bacteria or the nitrifying organisms which are most active in breaking up the filth and converting the organic nitrogen in the excreta into nitrates are contained in the superficial layers of the soil and this is the greatest requirement of shallow trenching system because the process is quick. The deeper the trenches, the slower is the process. In the case of deep pits, the filth may remain unaltered for years together, because the deep layer of earth contains very few bacteria. In addition the bacteria of the soil very quickly kill all pathogenic germs present in faeces and the urine.

Dangers of Trenching :—These are :—

(*i*) Pollution of the ground water and wells.

(*ii*) If trenches are not sufficiently deep, eggs of flies, which have been laid on the faeces may develop.

(*iii*) Superficial trenching of human excreta may lead to the exposure of nightsoil, in consequence of earth getting dried and blown away.

(*iv*) If not properly supervised, it may give rise to the nuisance of obnoxious smell.

II. Incineration of nightsoil :—If properly carried out in a well designed furnace it will be found to be sanitary and the danger of polluting water supply or the air through its smoke vapours will be reduced to the minimum. The incineration of nightsoil may or may not be combined with the incineration of streetrefuse. Where streetrefuse contains a large proportion of dry grass, straw, rags, paper scrapings, etc., these may serve as fuel. The incinerator should be installed near the latrines or near the paildepot. The sweeper should be present there constantly. The night soil should always be placed on the fire in small quantities at a time. A shed for the collection of dry fuel should be constructed near the incinerator. The incinerator is set going by placing a small quantity of little dry refuse and setting it on fire. When the combustion has proceeded for sometime then the contents of latrine pans etc., are poured over the smouldering material. For the efficient working of the incinerator, the chimney should be large and sufficiently high. Moreover, the number of air inlets must be adequate to ensure good draught. It is preferable to render the smoke inodorous either by providing a baffle plate or by placing a horizontal, grid

below the entry of flue. On the whole this method requires supervision and is costly.

III. Compost or "Manure" Making :—Composting is the process of biological fermentation and decomposition by which bulky organic refuse (may be animal or vegetable in origin) is changed into manure through the agency of living organisms such as bacteria, protozoa, actinomycetes, fungi etc.

The townwaste consists of nightsoil and urine, kitchen waste, sullage and sludge, while in the rural areas it mainly consists of cowdung, urine, cropwaste and housewaste.

The essential requirements of proper composting are :—

1. Suitable carbon-nitrogen ratio 30 : 1. The dry refuse obtained from the town and household sweepings is usually deficient in nitrogen, while nightsoil and cowdung are rich in it. For proper composting, a suitable admixture of the two *viz.*, the dry refuse and nightsoil or cowdung will be desirable. An admixture of about equal weights of the refuse and nightsoil would give the desirable carbon-nitrogen ratio of 30 : 1. If the proportion of night. soil is less, the decomposition will be slow. But when it is more than the actual requirements then there is a danger of loss of nitrogen taking place.

2. Presence of a suitable amount of moisture is essential for its proper decomposition. The quantity of water should be as much as can be retained by the material. If the amount of moisture is deficient the rate of decomposition would be slow, but if there happens to be an excess of moisture, there would be danger of water logging with consequent loss of nitrogen.

3. Aeration of the nightsoil in initial stages is beneficial but excessive aeration promotes rapid decomposition, resulting in unnecessary loss of the material and its nutrients. For proper decomposition, the mass should be neither too compact nor loose.

Procedure :—The following procedure is recommended for the preparation of compost manure in different cases :—(*a*) *Trenching ground* :—It should be situated at a distance of about 2 to 4 furlongs away from the nearest habitation. To avoid obnoxious smell coming into the town, it should not be located on the windward side.

(*b*) *Trenches* :—The size of trenches should be adjusted according to the amount of refuse likely to be available daily so that one or more trenches are completely filled up on any day. The breadth of trench should be 6 to 8 feet, so that an average size cart or truck could be emptied into the trench conveniently. The depth of the trenches should be about 3 feet. Given the breadth and the depth, the length of the trenches should be

adjusted to suit the amount of material likely to be available. Trenches are arranged in rows, so that longer sides are parallel and shorter ends are in the same line. There is an intervening space of 4 *to* 8 feet between one trench and the other. A suitable earth "bund" should be provided on all sides of the trenches to prevent rain water from flowing in.

(*c*) *Methods of Working* :—(*i*) *For Places Where Refuse and Nightsoil are Collected in a Mixed State* :—The material containing proper proportion of refuse and nightsoil (*i.e.* equal weight of each) should be dumped directly into the trench. While the cart is being emptied into the trench two men should be deputed (one on each side) for raking up and spreading the material evenly in the trench with long handled rakes. After the material is properly raked and spread over, a sufficient amount of water is added to moisten the materal. The addition of water should be done before another cartload is emptied into the trench. This procedure is carried on till the trench is filled up to 6–9 inches above the ground level, then a thin covering of earth or old manure, varying from 1 to 2 inches thick should be evenly spread over the material.

(*ii*) *For Places Where Nightsoil and Refuse are Collected Separately* :—In this case at first a layer of 9 inches thick dry refuse (free from brick-bats and other inert material) is spread over bottom of the trench. Then a layer of 2-3 inches emulsion of night soil is spread over it by means of long handled "*phaudas*." This is followed by another layer of dry refuse and alternate layering repeated with nightsoil and dry refuse till the trench is filled up to 9–12 inches above the ground level. The top layer in all cases being the dry refuse which is covered over with 1–2 inches thick layer of dry earth. This top-most layer of earth will prevent loss of moisture, breeding of flies and smell nuisance. If the earth covering is more than 2 inches thick, it is likely to hinder the proper aeration of the mass.

After a period of about 2–4 weeks the material in the trenches would settle down by 6–8 inches. In this case if need be, some more fresh material can be put on the top and again covered with a thin layer of earth.

(*d*) *Aftercare* :—During the hot weather there is a danger of the trenched material getting dry and therefore some water should be evenly sprinkled over the filled trenches from time to time.

The compost should be ready for use within four to six months depending upon the type of material used and the prevailing season.

(*e*) *Sanitary and Economic Aspects of Composting* :—If the system of composting is adopted as a routine method for disposal of habitation wastes, not only a large quantity of good quality manure is made available for cultivators but the sanitation of the towns also gets improved considerably. The smell and fly nuisance is also greatly reduced.

During the process of composting considerable heat (60°—70°C) is produced in the mass and this destroys most of pathogenic organisms, fly larvae, weedseeds and other obnoxious constituents and thus renders the resultant material practically inocuous.

In most cases the income from the sale of refuse after composting is much more than it is from the sale of the raw refuse.

Compost Making in Bunglows Where Land is Available i.e., on a Small Scale :—Select a piece of land in the farthest corner of the compound and dig a trench 10-15 feet long 2-3 feet wide with a depth of 3 feet on one side and 3½ feet on the other side. Get a small wooden plank or an iron sheet partition made for the purpose of demarcating a portion of the trench and fixing it at a distance of about 2 feet from the shallower end. Put dry refuse in the demarcated portion upto a depth of 9-12 inches and instruct the sweeper to deposit a day's output of night soil on this layer of refuse wastes. Cover the nightsoil layer immediately with another 9-12 inches thick layer of raw refuse wastes and sprinkle about ¼ to ½ inch thick layer of dry earth. It would be advantageous if a dusting of some common insecticide like gammexane is given before adding the earth. The above procedure should be daily repeated, but on the second day the sweeper should first spread over the nightsoil on the first day's deposit and then cover it over with the raw refuse wastes together with the insecticide and earth dust. This procedure should be repeated daily till the demarcated portion is filled upto a level of about 1½ feet above the ground level, when a dusting of insecticide be given again and the top covered with 2-3 inches thick layer of earth. After the demarcated portion is filled up as described above, the partition should be shifted to demarcate the next 1-2 feet portion of the trench and a similar procedure repeated till the whole trench is filled up and sealed as described above. After first trench is filled up, another trench of the same dimensions is dug parallel to the first one. The time taken in filling up the trench would vary according to the number of the family members, and their habits. Normally a trench 15 feet long, 2 to 3 feet wide and 3 feet deep should be enough for the deposit of refuse wastes over a period of 4 to 6 months. By the time second trench is

filled up, a good quality manure would be ready in the first trench.

Different modified processes of trenching have been tried at various places by different persons. They are as follows :—

1. Bangalore Method.
2. Indore Method.
3. Calcutta Tollygunge Method.
4. Howrah Method.

1. *Bangalore Method* :—It is advocated by all-India Institute of Hygiene. This is also called the hot fermentation process. In this method the length of the trench is divided into compartments each of which would roughly take one day's supply of nightsoil and refuse. About 1,000 cubic feet of trench space would be sufficient for every 10,000 of population and about 1500 to 2000 tons per year of compost will be produced.

2. *Indore Method* :—In this process alternate layers of refuse and nightsoil, three inches deep each, are placed in shallow brick lined pits to a depth of two feet six inches. If necessary these layers are slightly moistened during the filling process. The deposited material is turned to and fro by a wooden rake at intervals of 14 days. At the end of two months the mass is removed from the pit and stocked in rectangular heaps 10 feet broad at the base, 9 feet at the top and 3 feet 6 inches high and allowed to ripen for a month, after which it ripens and becomes ready for manuring the fields.

3. *Calcutta Tollygunge Method* :—A pit approximately 45 feet by 27 feet is constructed at the municipal trenching ground area by excavating 15 inches of the soil and piling the cut earth on the untouched side, so that the finished depth is 2 feet 3 inches. A 3 inches brick lining is laid in and the edges protected by a brick curb. Division walls are constructed to make 5 compartments of 400 cubic feet capacity. Besides, aeration and drainage channels are provided in the floor and the area around the pit protected with brick soling. In one of the compartments, a 6 inches thick layer of fresh rubbish is laid down and covered with a layer of nightsoil, which is again covered with a layer of refuse from the platform and the whole is lightly mixed, till all the nightsoil is taken up. A six inches thick layer of rubbish is again deposited and the process is repeated till the pit gets filled up. The filling of one compartment should be completed within two days. Within 5 days from the start, the pit contents must be turned to and fro by means of a long rake to ensure complete mixing. It should be turned over a second time after a further period of ten days. Subsequently two weeks later it can be removed and stocked and the whole process thus taking about one month. The heaps are left in the open to ripen till required and

are ready for use at any time, after they are allowed to ripen for another one month.

Disadvantages of the conservancy system :—These are as follows :—

1. The nightsoil remains in privies and latrines for a long time and putrefaction starts before removal. This gives rise to nuisance due to smell, atmospheric and soilpollution.

2. Nightsoil carts emit foul smell when wheeled on the roads, so in some places they are moved on the roads at night.

3. Latrines at different places cause inconvenience.

4. Conversion of unstable inorganic compounds of excreta into stable organic matters requires anaerobic conditions and an open place.

5. Insanitary conditions prevail due to employment of human agency for the removal of excremental matter.

6. It is not economical from financial point of view as it is very slow and involves dependency on labour at various stages as compared to the automatic functioning of water carriage system.

7. The wear and tear of the nightsoil carts, pails and other appliances is very great.

8. This system is manifested with the dangers of contamination of air and water and spread of infection through flies etc.

9. Rats may breed in the open privies where in addition to excreta there is generally an abundance of general house-hold refuse.

CHAPTER IV

WATER CARRIAGE SYSTEM

In the majority of large towns in England and in the highly advanced towns in India, human excreta and urine is now removed along with the liquid waste of dwellings by a flush of water by force of gravity through a system of drains and sewers leading to a far off place outside the town.

Sewage :—It comprises excreta, urine, housewaste and rain water, together with solid and liquid refuse from cowsheds, stables, houses and factories etc.

Sullage :—Waste water from houses etc., unmixed with solid excreta is usually known as 'Sullage'.

Conditions essential for the successful working of the water carriage system are :—

(*i*) Availability of an abundant supply of water for flushing waterclosets.

(*ii*) Provision of good underground drains and sewers with proper ventilation.

(*iii*) Sufficient fall to give the required velocity to the sewage.

(*iv*) Proper means of utilisation of sewage.

A complete lay out of the water carriage system consists of :—

(*a*) A system of house drainage leading to sewers.

(*b*) A system of sewers.

A complete system of house drainage consists of water closets, soilpipe, housedrain with manholes or inspection chambers, leading to a public sewer.

A.—**Water closet** :—It is a sanitary installation for the reception of the human excreta and is connected with the soilpipe. It should fulfil the following conditions :—

(*i*) It should be made of hard, smooth and impermeable material as glazed stoneware, fire clay or porcelain.

(*ii*) It should be of wash-down pedestral form.

(*iii*) The posterior wall should be vertical.

(*iv*) It should have 2 inches of waterseal.

(*v*) It should have flushing rim all around.

(*vi*) Trap and pan should be in one piece.

(*vii*) The trap should be of S or P type.

(*viii*) It should have a hinged seat.

(*ix*) Height of the closet should not be more than 18 inches.

(*x*) Closet should be fixed in a compartment with at least one external wall and a window of the size of 2 feet x 1 feet opening to the outer air, half of which must remain open. There should be a provision of crossventilation.

(*xi*) Flushing should be efficient to remove all traces of excreta with minimum amount of water.

Parts of a Watercloset :—It consists of the following :—

1. Closet proper with the basin and a trap.
2. Flushing Apparatus.

Varieties of Waterclosets : They are :—

1. *Pan Closet* :—It consists of (*a*) a basin, shaped like an inverted cone, (*b*) a pan which guards the outlet of the basin and is opened or closed by a lever mechanism which is also connected with the flush. The pan when closed always contains some water. (*c*) A container or a receiver in which the pan opens and throws the contents into (*d*) the trap, underneath the floor with which the container is connected. It is not considered as a good closet because :—

(*i*) Its mechanism is not simple and may go out of order.

(*ii*) When the pan opens, it splashes the excreta all around into the interior of the container and on the under surface of the pan. The excreta sticks, decomposes and gives rise to offensive odours which enter the room when the pan is opened.

(*iii*) It requires a large quantity of water for cleansing purposes and even then it is not sufficiently cleansed. Its use is not advocated on account of its drawbacks. In fact, its use is prohibited in some places by enforcing model by-laws.

2. *Valve Closet* :—It is similar to pancloset but instead of the pan, there is a movable valve fixed to a metal box by means of a hinge which opens out on raising the handle. Its lowest part is connected with a siphon trap leading to the soilpipe, immediately after each visit, the closet should be flushed with plenty of water. Arrangements should also be made for an after-flush for the supply of water into basin after the handle is released.

The advantages claimed in this form of closet are :—(*a*) It is noiseless. (*b*) All excreta falls in water, therefore closet remains always clean. (*c*) When the valve is opened, the water and excreta form a very powerful preliminary flush, thus keeping it clean.

Disadvantages are :— (*i*) It produces splashing. (*ii*) On account of dislocation there may be leaking of the valve, which at once destroys the utility of the closet, as the faeces fall in the valve, which being rough cannot be cleaned adequately. In consequence of the leakage of water, there is no waterseal, which leads to the emission of foul smell from the chamber below the valve.

3. Long Hopper Closet :—It consists of a long inverted stoneware cone, connected below with a trap which retains sufficient quantity of water. Being long, about 16″, the solid excreta adheres to the sides which are apt to become fouled to a great extent and therefore a great force of water is required to flush it well. It is difficult to flush it properly because the force of water is broken and water whirls round and round.

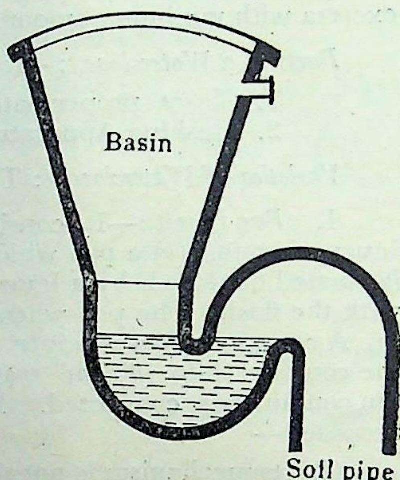
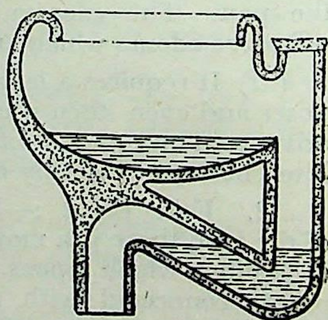


Fig. 21—Long Hopper Closet

The pan, the valve and the long hopper closets are no doubt cheap, but being unhygienic and their working unsatisfactory their use has now been discarded.

4. Washout Closet :—It is constructed of a stoneware basin so shaped that a small quantity of water remains in it to receive the excreta which is flushed out over the edge of the basin into a trap below. As the excreta has to be flushed over to this edge, a powerful flush is required for its cleansing. This form of closet is not without defects for foul matters often stick on the edge of the basin and the water contained therein is not always enough to cover them.


Fig. 22—Wash out Closet

5. Siphonic or the Jenning's Century Closet :—It resembles washdown closet, with the difference that the ascending arm of the siphon trap is continued upwards so that the water in the basin stands at a comparatively higher level and a deeper seal is formed. The descending arm terminates into a second siphon before it joins the soil pipe. When the closet is used siphon action is started by the inflow of water both through the siphon pipe and

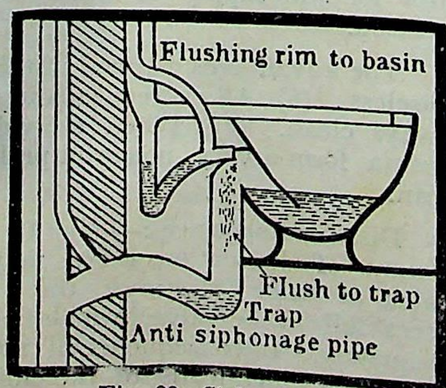


Fig. 23—Siphonic Closet

the main pipe, the former discharging water into descending arm of the siphon and the latter into the flushing rim to the basin. This form of closet is comparatively clean though expensive. It is better in the sense that it works with a very short pull of chain.

6. *Wash-down or the Short Hopper Closet* :—It is most commonly used nowadays and in fact this type of closet has eliminated all other types as it fulfils all the requirements of an ideal closet. It consists of a short inverted cone, with almost vertical back, which dips into the water contained in the trap for about two inches to form the waterseal ; excreta falls directly in the water of the trap and gets cleaned by a flush. It has flushing rim by which the sides are kept clean.

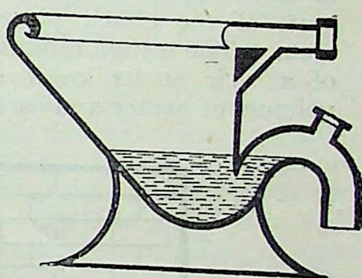


Fig. 24—Wash down Closet

7. *Modified Indian type of Closet* : In India, majority of the people are in the habit of squatting at the time of defaecation, therefore the basin or the pan is provided with two footrests, one

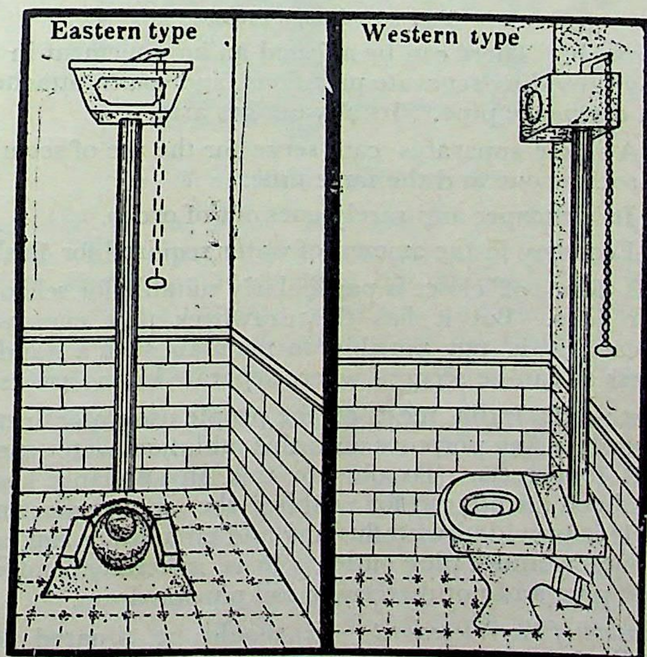


Fig. 25—Water Closets

on each side of pan proper, the pan with the trap being placed

flush with the floor of the closet compartment. The floor and the foot rests are made of hard smooth impervious material such as tiles or cement.

8. *Trough Closet* : It consists of a long metal, masonary or earthenware trough placed on an inclined plane under the seats of the closet, placed side by side, for the reception of excreta. The trough retains a certain amount of water by means of a weir at its lower end and the excreta are expelled by a volume of water and carried away through a trap placed at the

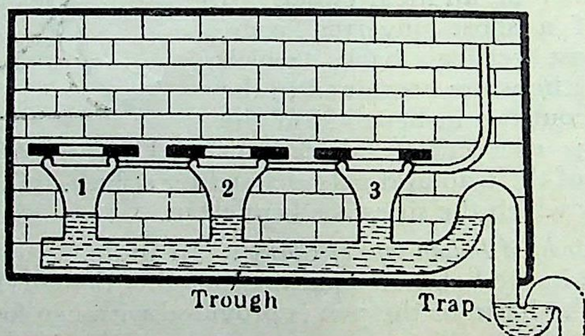


Fig. 26—Trough Closet

end of trough. There can be affected an improvement in trough closet, by providing separate partitions and pans attached to a common discharge pipe. Its advantages are:—

(*i*) A single apparatus can serve for the use of several persons at one and the same time.

(*ii*) It is cheaper and rarely goes out of order.

(*iii*) Economy in the amount of water required for flushing.

This form of closet is particularly suitable for schools, hospitals or jails. But it has the drawback that even with the utmost care it is not possible to maintain such a standard of cleanliness as can be secured where separate basins are used.

Bidet :—In India most of the people use water instead of paper for cleansing purposes and this ablution water spoils the seat and foot rests. To obviate this an appliance known as *Bidet* has been introduced for washing the anal region and perineum. It is provided with flushing and circulating rim, an open stream outflow and a plug outlet. It is generally connected to the waste pipe and not directly to soil pipe or drain.

Situation of the Wtearcloset :—It should be situated near the outer wall of the house. The floor should be made up of white tiles which should be carried around the wall also upto a height of 3 feet (*viz.* dadow). The closet should be mounted bare,

without any wooden structure and supply pipe should be kept free on the wall and painted white. There must be provided a window opening directly into the open air. The rest of the wall should be distempered with a waterproof paint. The room should contain nothing else except the watercloset. The practice of putting a bath tub in the same room is now being stopped. The water closet is connected to the soilpipe by a S shaped bend called the trap.

2. **Flushing Apparatus** :—Water for flushing the water closet is provided by means of separate flushing cisterns which are limited in their capacity (*viz.* 2 gallons). The water closet is constructed to work with that amount and the cistern is placed above the closet at a height of not less than four feet and is connected directly to the closet at the flushing rim. The cistern

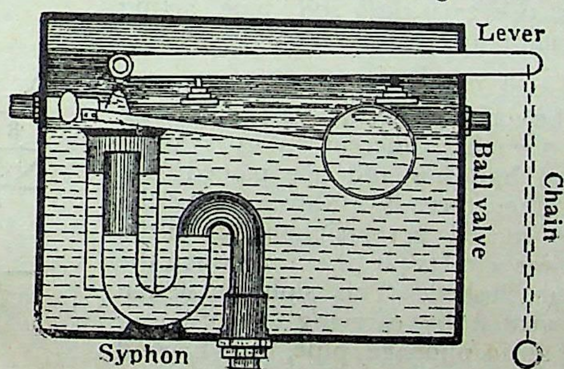


Fig. 27—Siphon Flushing Cistern

is connected to the house watersupply and is controlled by a ball valve. The cistern delivers its water by siphon action and is set in motion by pulling a chain and let going it. The flushing rim must go all around the closet, and for the satisfactory operation of the flush system it must be distributed over the entire surface of the closet.

B.—Soilpipe :—It is a circular pipe carrying the contents of the water closet to the house drain. It is made of cast iron or milled lead. It has an internal diameter of about 4 inches. It is carried clear of the window 6 to 8 ft. above the roof for escape of foul gases. Its end may be covered with wire gauze dome. To prevent oxidation or rusting, iron soilpipes are coated either with a paint containing magnetic oxide of iron called Barff's process or may be dipped in Angus Smith's Varnish, which is composed of pitch, asphalt and tallow. Lead pipes can be more conveniently and expeditiously erected. These pipes should preferably be fixed on the shady side of the house so that the

joints may not be damaged in the heat of the sun. The soil pipe should be placed against the outer wall of house so that it may be easily inspected and extended beyond the roof. To allow a free circulation of air and the escape of foul gases generated, the loose end of the pipe should open over a disconnecting trap outside the house. Moreover its upper end should be carried on to at least 5 ft. above the roof of the house. It has been found through experience that the soilpipe should open directly into the housedrain without an intervention of a trap, as it imposes a useless barrier to the sewage and prevents the soil pipe acting as a drain ventilator.

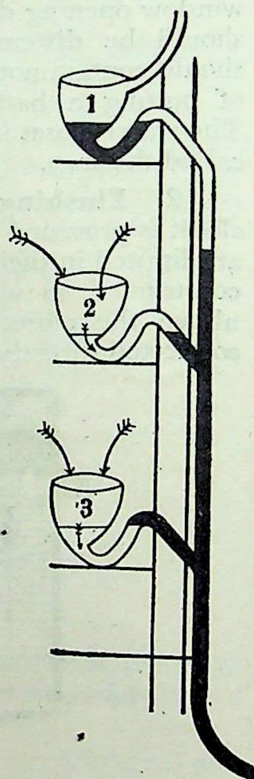


Fig. 28
Three closets at different levels explaining siphonic action.

Antisiphonage Pipe :—When the soil pipe happens to be common for the various closets constructed for the different storeys of a multistoreyed building and are placed one above the other there is always a risk of the water being sucked in or siphoned from the traps of lower closets at the time when the upper ones are flushed. This siphonic action can be prevented by carrying a ventilating pipe, called anti-siphonage pipe, from beyond the trap of every closet, through the house wall and is connected with a vertical pipe 2 inchees to 2½ inches in diameter placed along the side of the soilpipe, after it has received the antisiphonage pipe from the highest water closet.

C.—Housedrain :—It is an underground pipe, connecting the soilpipes with the sewer. It also receives waste water from the house or the compound and the rain water.

The main house drain is made up of glazed stoneware or earthenware socketted pipes, 2 ft. in length, or when placed under the road it is made from socketted castiron pipes coated inside with a paint containing magnetic oxide of iron (Barff's process). Stoneware pipes are connected with cement and cast iron pipes are caulked with moltenlead. It is laid on a bed of concrete in a straight course, with the socket end looking towards the house and the spigot end towards the sewer. It should be laid without any angles or bends on a smooth inclined plane to facilitate easy transit of its contents. Its interior should be per-

fectly smooth to prevent accumulation of filth. Housewaste, kitchen and rain water pipes drain in the house drain at an acute angle and never at right angles. The joints should be made both air and water proof. Moreover, these pipe connections should be made in the direction of flow of the contents of the pipe. A four inches drain should have a fall of 1 in 40 and a six inches drain a fall of 1 in 60. It should also be provided with inspection openings of manholechambers at convenient intervals. It should be noted that a small drain is more liable to selfcleansing than a large one but care should be taken that it is wide enough to prevent blocking and to carry off all the sewage of the house as well as rain water.

The house drain should not be allowed to pass through or under a house. There should be a proper arrangement for flushing the house drain. The requirement of a good house drain are : —

(*a*) Perfectly fitting joints to eliminate the danger of leakage of any sewage or foul gases.
(*b*) The provision of a proper flushing arrangement.
(*c*) A fall to provide velocity to the current.
(*d*) The pipes should have smooth internal surface.
(*e*) The pipes should have Y joints *i.e.*, they should form an acute angle and not right angle.
(*f*) It should be easily accessible.

D.—Inspection Chamber or Disconnecting Chamber or Manhole :—It is a square shaped, brick built and cement

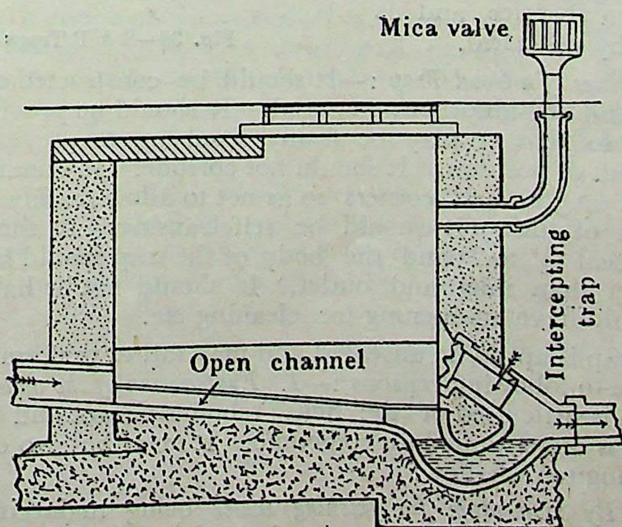


Fig. 29—Inspection Chamber

lined underground chamber. The main housedrain is continued along the floor of the chamber in a half channelled glazed pipe, which discharges itself into an intercepting trap. The branch drains and the subsidiary drains are also made of glazed channelled pipes and are connected to the main channel. The chamber is closed by an iron lid and from its side a ventilating shaft provided with a mica flap, lets the air in but not out.

At the distal end of the chamber, an intercepting trap is provided which has on it an inspection arm which is closed by a lid. The object being to permit rodding of the short length of pipe leading from the trap to the sewer. This intercepting trap prevents reflux of foul gases from the sewer and the entrance of sewer rats into house drains, but allows a free circulation of air through the drain and soilpipe. The house drain must be adequately ventilated at intervals by providing an air shaft passing upto gratings at the surface of the ground or these may be carried away to the side of the house to prevent nuisance. Arrangement for the inlets and outlets should be made to ensure free circulation of fresh air.

E.—Traps :—A trap consists of a pipe, bent upon itself in such a way so as to retain certain amount of water in the bend. It prevents the reflux of sewer air or gas into the house and acts as a barrier and is effected by waterseal.

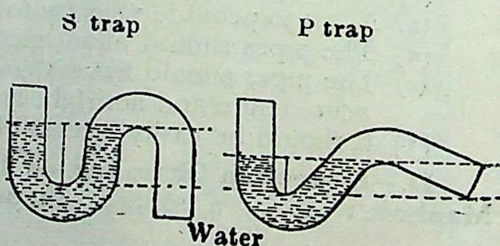


Fig. 30—S & P Traps

Qualities of a Good Trap :—It should be constructed of strong, smooth and non-absorbent material. It should be provided with a base, so that it may be firmly fixed up to prevent it from getting out of position. It should not corrode. It should be free from all angles and corners so as not to allow readily the accumulation of filth. It should be selfcleansing. It should have a waterseal 1½″ to 2″ and the body of the trap should be smaller in section than inlet and outlet. It should not be liable to silt and should have an opening for cleaning etc.

A trap is apt to be unsealed and may fail to perform its functions due to following reasons :—*1. Evaporation of the water seal* :— If a trap is little used or the house remains vacant and the use of the trap is discontinued for sometime. It may be also due to the bend being too shallow.

2. By momentum for flushing water being maintained to the vertical line, in different storeys of a multistoreyed building and if the closet in the upper storey is flushed, then water of the

traps in the closets fitted in lower storeys will get aspirated. This is prevented by the provision of antisiphonage pipe.

3. *By momentum of flushing water* being maintained to the very end of flushing, due to sudden and violent discharge of water.

4. *By backward passage of gases* when the drain is not adequately ventilated.

5. *By capillary action* caused by foreign substances like pieces of cotton, thread, jute, etc. which may be caught in the trap and act as siphon. The remedy is adequate flushing.

6. *Traps* may also be rendered useless on account of getting blocked with deposit of solid matter due to imperfect setting or insufficient fall in the house drain.

Varieties of Traps :—These are as follows :—

1. *Siphon Trap* :—It is simply a bent tube placed under the basins of each water closet. It is of the P or S type trap according to the outward or downward direction of the outlet. It is the best type of trap as it maintains siphonic action and keeps a constant level of water. In this case water collects at the lower bend of S and the water seal should be 1½" to 2" deep. Anti D type of trap is generally condemned as it is not selfcleansing.

2. *Gully Trap* :—This is interposed between rainwater and wastewater pipes and the underground house drains in court yards. It is made up of iron or glazed earthen-ware. It is fitted at a distance of about 18 inches from the wall of the house and is intended to arrest the solid suspended matter in its downward passage and allows the rain or muddy water to flow into the drain. It is required to be cleaned periodically. The most convenient is Dean's Gully trap which contains a removable bucket or a trpe for collecting solid materials, which may be removed periodically The Bell trap is not a good type because in this case the water seal is easily broken. Similarly the use of midfeather trap has been discarded on account of its imperfect functioning.

Gully trap



Fig. 31
Gully trap

3. *Grease Trap* :—It is fitted to the kitchen sink to prevent the choking of drains, due to collecting and congealing therein of grease. The trap is made up of earthenware or iron and contains a large volume of water which allows the grease contained in it to float to the surface and solidify and thus arrests its inward flow, and allowing the dirty water to flow away from its under surface.

Testing of Drainage System:—Testing of drainage system is always necessary. These are frequently tested after laying new

house drains and periodically in the case of all old ones. The tests which are commonly used are :—

1. *Water Test or Hydrostatic Test* :—This is especially used in new drainage works or when they are still being constructed. To carry it out, plug the lower end of the waste or soil pipe with a suitable water tight plug and then fill it gradually with water. Then if the level of the water falls or if the drain does not fill at all, it indicates a defect at some point and the point should be carefully examined. But if the water level remains stationary for an hour or two the drains under observation are sound and watertight.

2. *Chemical or Scent Test* :—Pour out a small quantity of some volatile oil, like that of peppermint oil, in a bucket of hot water and discharge it through a watercloset or down the pipe from the highest available point. If on examination, a peculiar smell of peppermint is perceived this will indicate the situation of the defect. This test is, however, not very reliable. The operator must be careful not to soil his clothes with the oil, otherwise he will carry the smell with him all over the house.

Another method is to use glass capsules containing Calcium Phosphide or Phosphorus and Asafoetida. Dense white fumes are produced when it comes in contact with water and are detected when they emerge out through a defective joint or a crack in the drain.

3. *Smoke Test* :—The top of the ventilating shaft is closed before applying this test. This test consists in filling the whole sanitary system with smoke by means of bellows. If there is any leakage any where, the smoke will be seen escaping in the house, and thus exposing the defect. Special smoke testing machines are used for this purpose.

4. *The Pneumatic or Air Test* :—This is the most recent method and consists in driving air under pressure of 2 to 4 inches water by a pump to which is attached a pressuregauge after all the openings of the sanitary system are securely plugged. The presence of any leakage is evidenced by lowering of the pressure in the gauge and point of leakage is detected from a hissing sound produced at the point of leakage.

5. *Ball Test* :—This test is applied to new drains, prior to laying their coverings, just to find out any obstruction. Usually a ball of the diameter 1/4" less than that of the pipe is rolled down from one end of the drain to the other.

SEWERS

A sewer is an underground trunk channel, in which house drains empty their contents. It carries them to the place of

disposal. It is also required to carry household and trade effluents, rain or storm water and the water used for municipal purposes. It is provided with manholes and flushing gates for inspection and cleansing. It is generally built of glazed bricks and given the shape of an egg on cross section, the idea being that it flushes better by providing that shape.

There are two systems of sewers :—

1. **The Combined System** :—In this system the sewer carries away all the storm or rain water from the streets, along with factory drainage, excreta, etc. The sewers in this system ought to be very large which create great difficulty in places where there is less rainfall.

2. **The Separate System** :—In this system all storm or rain water is taken away by separate drains and disposed off altogether apart from the sewage. It is an expensive method but undoubtedly the best and is now being adopted largely because no difficulties are introduced with regard to the Sewage disposal.

The advantages claimed by the separate system are :—

(i) The sewers required are of smaller dimensions and so are easily flushed, consequently there is less deposit.

(ii) The sewage is uniform in quality and smaller in quantity.

(iii) Purification and utilisation are effected with less difficulty.

(iv) In a known population, estimation of total bulk of sewage can be done from allotment of water per head.

(v) It is cheaper to run than the combined method.

The disadvantages are :

(i) Two sets of pipes are required for every house, so wrong connections may be established through an oversight.

(ii) The rain and storm water may wash away impurities that would contaminate a stream.

(iii) The flushing effect of rain water on sewers is lost.

Under no circumstances a public sewer should be less than 9″ in diameter. Sewers upto 18″ in diameter are constructed of glazed earthenware or stoneware pipes and are circular in shape. They should be laid on a bed of concrete to prevent subsequent sinking. Sewers of larger diameter are made of glazed bricks or cement and are oval or egg shaped with their narrower end downwards, as they provide a greater depth of sewage and comparatively less contact with the inside surface of the walls, which obviously minimises the friction.

Sewers are placed underground, usually at a distance of 10 feet from the surface of the road. All sewers must be laid with as few bends as possible and the junctions are made at acute angles to allow the sewage to pass in the direction of flow. Curves, if any, should be gradual. The joints of the sewers should be thoroughly cemented and their inside surface must be

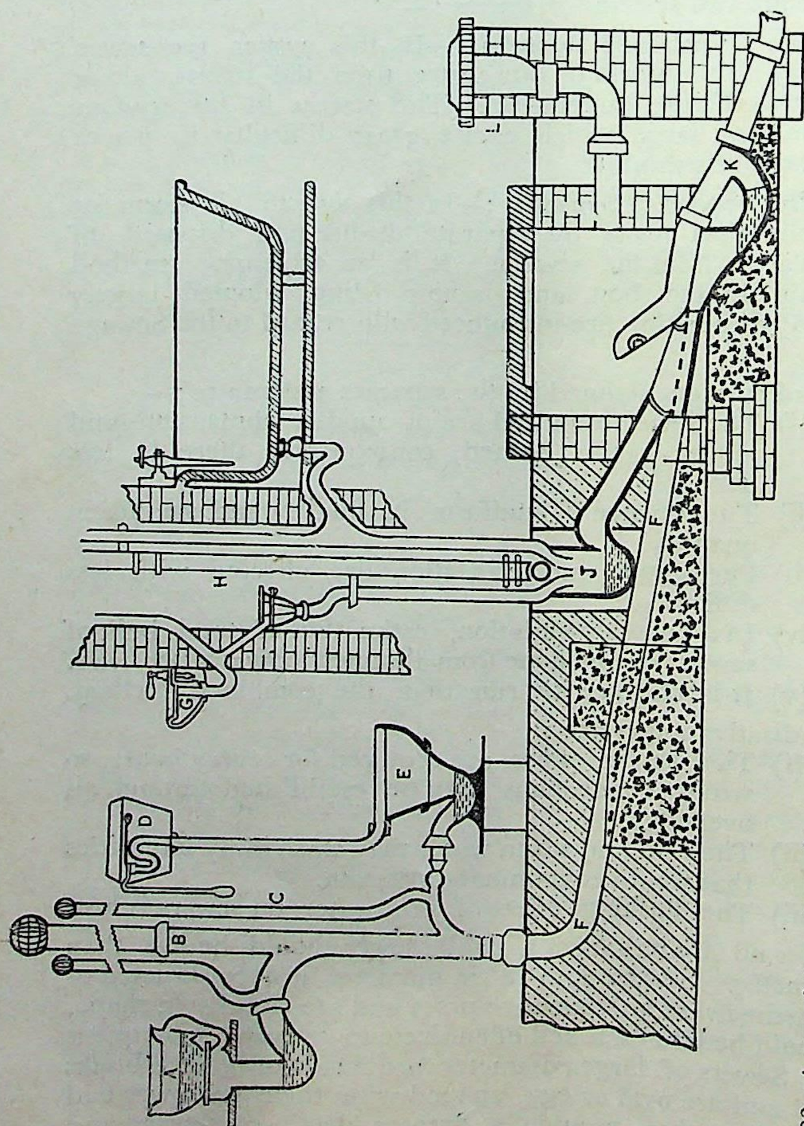


Fig. 32—A complete system of house drainage. A & E are two closets which open into the soil pipe B- C. Anti siphonage pipe, D. flushing cistern which opens into closet E, F. house drain, G. washbasin, I. bath tub, J. Gully trap, K. Intercepting trap, L. Inlet opening.

perfectly smooth. Sewers should be self-cleansing and provided with sufficient gradient. The size should be proportionate to the volume of sewage they have to convey.

Inspection, Cleansing and Ventilation of Sewers :—For periodical examination and cleansing of sewers, manholes are provided. These are side entrances into sewers provided at an interval of 100 yards throughout its course. It consists of a masonarychamber down to the sewer through the centre of which the main sewer runs. The branch sewers are made to join the main sewer in the manhole chambers.

Flushing Gates :—These are contrivances placed at the ends of sewers for purposes of efficient flushing and to prevent stagnation of sewage material at their bottom. For efficient flushing automatic flush tanks may be constructed or a hose pipe be run into a manhole from a hydrant or water carriers be engaged for this purpose. The sewers may also be flushed by pouring large quantity of water into them through manholes.

Selfcleansing:—It is considered essential that sewers should be as much selfcleansing as possible. An even flow of sewage should be aimed at, so that it does not "pond" or accumulate at any spot. Ponding or obstructing may cause the sewage to go back into the house drains and may lead to even disturbances of ventilation in the sewer proper with the accumulation of inflammable gases. These conditions endanger the lives of workmen working in the sewers.

Ventilation of Sewers :—In a properly constructed sewer, where the sewage is welldiluted, its flow is rapid and flushing efficient, deposition of deposit does not occur and so the air does not become foul.

In badly constructed and even in other sewers, owing to the constant variations of the flow some deposit forms which putrefies and gives rise to obnoxious gases such as carbon dioxide, marsh gas, hydrogen sulphide, ammonia, carburetted hydrogen, etc. The gases evolved being combustible, so unprotected lights should not be brought in the newly opened sewers. In tropical countries the temperature of sewer air is lower than that of atmospheric air. Bacteria have a tendency to adhere to the damp surfaces of the internal walls of the sewers. Hence the provision of ventilation for the sewers is most essential to dilute such gases and to preserve the purity of such air.

The method utilised for the purpose is, to fix long iron shafts at a suitable distance, say 100 yards, along the entire length of sewers. They are carried sufficiently high above the top of the neighbouring houses for the exit of sewage air or gas into the atmosphere. The other method is to have perforated manhole

covers having a tray or a dirt box below it to catch dirt and stones etc., with the idea that the air which escapes through these would be rapidly diluted by fresh air and rendered inoffensive. They are installed at a distance of 100 yards. Some of them act as inlets and the others as outlets.

Disadvantages of sewers are as follows :—

(*i*) Sewers might cause effluvia to enter into houses. But however, if they are properly constructed, flushed, trapped and ventilated, this may be prevented.

(*ii*) Any leakage may contaminate water supply. A sewer may begin leaking on account of various reasons *viz.*, from sinking of foundation, cracked or faulty joints of pipes or by penetration of roots of trees through cracks etc.

(*iii*) Accidents in sewers :—Workmen who enter parts of a sewerage system for cleansing them, sometimes die being asphyxiated by poisonous gases from the sewers.

Precautions to be taken before cleansing the sewers :—These are :—

(*i*) Six of the manholes along with the whole length of the sewer should be uncovered at least 2 hours before any one enters therein.

(*ii*) Test the atmosphere of the sewer by letting in a lighted lamp and see that it burns brightly.

(*iii*) The workers in sewer should not be allowed to remain for more than half an hour at a time in the sewer.

(*iv*) If a worker in the sewer, gets ill or becomes unconscious, he should be at once taken out and given artificial respiration and medical aid to restore him.

(*v*) At least two or more workmen should enter the sewer at a time. They should be fastened by a stout rope. They should work under the supervision of the chief sanitary inspector.

(*vi*) The work should be carried out between sunrise and sunset and never during the night.

Pneumatic System of Sewage Removal:—In this system two sets of pipes are used *viz.*, pipes with smaller diameter for the removal of waste water and the pipes with larger diameter (5 inches) for the removal of sewage. In low lying areas where removal of sewage by gravitation scheme cannot be efficiently carried out, for want of proper gradient, some other mechanical means are to be adopted. In such cases periodical pumping to raise the sewage to a higher level should be resorted to.

For this purpose an automatic apparatus such as Shone's Ejector is used. This apparatus consists of a closed tank into which sewage gravitates. The motive power is compressed air supplied from a central station. The pressure of the air, is sufficient to lift the sewage into a sewer at a higher level.

CHAPTER V

DISPOSAL OF SEWAGE

The character of sewage depends upon the amount of water consumed, the social habits of the people, admission of rain water and the character of effluent from different trades and industries. The main object of disposal of sewage consists in changing the different organic matters, present in the sewage from unstable into harmless stable chemical compounds.

The chief methods of disposal of sewage are :—

(*a*) by dilution ; (*b*) by purification.

(A) **Sewage Disposal by Dilution** :—This is done in the following ways :—(1) **Discharge of Sewage into the Sea.**—This is the readiest, the most economical and the best practicable method of disposal of sewage of the towns situated on sea side. The sewage should be discharged well below the lowest level of the ebb of the tide so that the discharge may not be driven back on the foreshore during the incoming tide. A sea outfall should be taken as far as possible from the shore. The liquid of the sewage rapidily becomes diffused in water, but the solid matter may persist for some time, especially as the sea water delays the oxidation of solid organic matter and it is not until some hours after discharge that putrefaction sets in, whereby it gets broken up and dissolved by aerobic bacterial action. The possibility of infecting shellfishlayings must always be borne in mind.

(2) **Discharge of Sewage into Rivers** :—This was formerly practised in England and the result was most undesirable. In fact, an act had to be passed in England in 1876 prohibiting the discharge of crude sewage into rivers. This act is called the River's Pollution Preventive Act. The sewage must be purified, before it is discharged into a river because in England the rivers are very small and may be very readily polluted.

In India the rivers are much larger, but even here the discharge of crude sewage should be prohibited. Such a discharge is liable to prove much more injurious, if the discharge of the sewage is allowed to take place at a point up the stream so that the people living below are constrained to use the polluted water.

Before discharging the sewage into the sea or a river it should be ascertained whether the diluton will be sufficient or not. Comparatively less dilution is required in the case of a rapidly flowing river than in the case of a stagnant river. The volume of water should be enough to permit, aerobic bacterial action which will effect the complete break down of the organic

matter and at the same time will not kill fish. The current must be sufficient to prevent silting up of the stream and there should not be any possibility of the floating materials getting deposited on the shore.

(B) Sewage Disposal by Purification :—The different methods of sewage purification may be described as follows :—

1. Direct land treatment.
   (*a*) Intermittent downward filtration.
   (*b*) Broad irrigation or sewage farming.
2. Chemical treatment of sewage.
3. Biological treatment.
   (*a*) Septic tank.
   (*b*) Activated sludge process.

1. Disposal by Direct Land Treatment :—It can be done in two ways :—

(*a*) **Intermittent Downward Filtration Method** :—By this method sewage is purified by the action of soil which acts as a mechanical filter and for this purpose a porous soil should be selected. Sand, clay and peat are unsatisfactory and chalk is dangerous for this purpose. The purification is chiefly effected by the soilbacteria or the nitrifying organisms which exist in large numbers in the superficial layers of all soils, especially in land rich in organicmatter, aided by those contained in the sewage. These bacteria require air and oxygen for their development and on account of feeding of the organic substances of the sewage, cause their oxidation.

Here the earth is made to act in much the same way as a sandfilter is used for waterpurification. The growing of crops if practised at all, should be a matter of secondary importance.

For successful filtration the land should be prepared in a fashion of beds. The bottom of the bed should be properly drained by means of porous earthenware drains laid at a depth of 6 feet and about 10 feet apart from each other. The surface of the land should be levelled and must have a proper slope to allow the equal distribution of sewage over the whole area. The sewage should be distributed through surface channels. The land should be divided into 4 sections so that each section may receive the sewage for 6 hours and have an interval for aeration for about 18 hours. The surface of each section should be laid out in ridges and furrows and cultivation may be carried on the ridges while sewage is permitted to flow down the furrows. The effluent, which comes out of the subsoil drain, is pure and does not putrefy and can be discharged into any river or stream. The method is simple and works efficiently where

plenty of suitable porous soil is available. One acre of land is sufficient for treating the sewage of about 3000 persons.

(b) **Broad Irrigation or Sewage Farming** :—A considerably large plot of land is required for this system and it is generally adopted where a suitable land is available near the neighbourhood of a town. The soil should be porous and the land selected low enough to allow the sewage to flow by gravitation. The untreated sewage is used to irrigate a given area of land on which crops, etc., are grown and the ordinary processes of agriculture are carried out. If proper extent of land is not available and the land be overdosed with sewage, it becomes "Sewage Sick" and will not grow any crop at all. So a considerably large area of land is required for efficient manipulation of this system. The growing of crops is the main consideration. The land should be used for growing fodder for horses and cattle and other crops rather than the production of vegetables.

The sewage should be discharged on the land in a fresh condition and the coarse portions should be removed by precipitation or sedimentation. Irrigation of sewage should not be continuous but must be intermittent, so that the aeration of the soil can take place during the period of intermission. The land is laid out in the ridge and the furrow system and the sewage flows down the centre of the ridge towards the furrow. One acre of land is required for about 100 persons in temperate climates.

In Amritsar, the sewage is run to the direction of the land belonging to certain zemindars, just like a water course, who use it as an ordinary canal water. This is a source of revenue to the municipality. In this system, however, there is this drawback that during the rainy season it is difficult to take care of sewage and prevent water-logging.

2. Chemical Treatment of Sewage :—This is effected by the addition of certain chemical agents such as lime, alum, alumino ferric, mixture of lime and alum, etc. These chemicals act as precipitants and carry down suspended matter with some dissolved organic impurities of the sewage.

Crude sewage is at first collected in large tanks made of cement called settling tanks, the solid matter gravitates leaving a comparatively clear fluid at the top. This fluid is then treated with certain chemical agents which act as precipitants. The sludge or the precipitate, is then pressed into cakes and sold as manure. The clear, supernatant fluid, at the top is called effluent. This may either be discharged into a stream or a river or carried along drains into land for the purpose of irrigation. The disadvantages of this method are numerous. The sludge is very bulky and has very little manuring value. The effluent

is not safe as it is not free from pathogenic organisms. So this method is not much adopted now.

The chemicals commonly used for this purpose are :—

(*i*) *Lime* :—12-16 grains of lime are added to each gallon of sewage. It combines with carbonic acid of the sewage forming an insoluble carbonate of calcium and also with some of the sewage, the precipitate falls to the bottom forming sludge. This method is cheap and simple. The disadvantages are that the effluent is rendered more alkaline and more putrescible and the sludge is bulky and decomposable.

(*ii*) *Alum or Aluminium Sulphate* :—5-10 grains is used for a gallon of sewage. This causes a flocculent precipitate which entangles and carries down most of the suspended organic matter present in the sewage.

(*iii*) *Lime and Alum* :—5 grains of each of the chemicals are added to a gallon of sewage. This method is more efficient than lime or alum alone.

(*iv*) *Amine process* :—Sewage is treated with a mixture of lime and a small quantity of brine. An amine is formed, which acts as a deodorant or an antiseptic and renders the sludge also antiseptic.

(*v*) *A. B. C. Process* :—The chemicals used are aluminoferric, blood, clay and charcoal. They produce a precipitate which causes sedimentation of the dissolved solids present in the sewage.

(*vi*) *Iron sulphate or Copperas* :—It forms a precipitate of hydrated protoxide of iron, when added to alkaline sewage or to the sewage which has been previously treated with lime. Usually 3 to 5 grains of it are sufficient to treat one gallon of sewage.

3. **Biological Treatment** :—This process reduces the complex organic matter present in excreta into simple substances by the action of bacterial and other microorganisms. Their main action depends upon the two kinds of bacteria present in sewage i.e., aerobic and anaerobic. The anaerobic bacteria are chiefly concerned in reducing organic substances into simple compounds by breaking down, digesting and liquifying them, which are ammonia and ammoniacal compounds. The aerobic bacteria convert, by a process of nitrification, the ammoniacal substances into nitrites and nitrates. The disposal of nightsoil by trenching, sewage farming, etc., are biological methods as the ultimate results are obtained through the bacteria present in the soil.

There are various methods of biological treatment :—

(*a*) **Septic Tanks**:—This system was first devised by Cameron and actually put into practice by Fowler and Clemesha in 1906. By this process the combined action of two groups of organisms viz., anaerobic liquifaction and aerobic nitrification is utilized for the purification of sewage. The anaerobic liquidation takes place in septic tank whereas aerobic nitrification takes place in the contact beds or the sprinkling filters. The sewage is at first passed into a *grit* or *detritus* chamber, where all heavy stones, bricks, etc., fall to the bottom, while hard lumps of faeces float on the surface. The grit chamber is 1/8th of the size of digestion chamber or the septic tank proper.

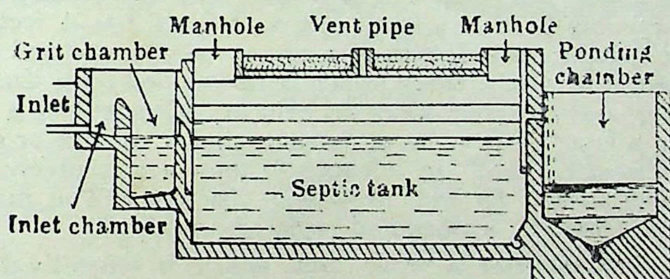


Fig 33 :—Section of septic tank installation for a house.

The digestion chamber is an underground, airtight, rectangular tank made of bricks. It may be kept open or closed but in India it should be closed to suit its climatic conditions. It has an inlet pipe connecting the two chambers at a distance of 1 to 1½ feet above the bottom for receiving the sewage, and an outlet pipe for the discharge of effluent. The capacity of the tank should be equivalent to 24 hours flow of sewage.

In the septic tank proper, some of the solid organic constituents settle at the bottom and the scum about 2″-6″ thick is formed which floats at the surface, which should not be disturbed. Under the scum, anaerobic microorganims grow and multiply in the tank and bring about material liquid action of the suspended organic solid matters and split them into soluble and unstable compounds. The black deposit of the sludge accumulates at the bottom of the tank, which is generally small. As soon as it becomes 8″-12″ in thickness, it should be removed and deposited in trenches. The scum further undergoes digestive changes owing to the action of anaerobic bacteria and the organic matter is decomposed into water, nitrites, nitrates and gaseous products, such as carbon dioxide, ammonia, marsh gas, sulphuretted hydrogen, etc. These gases may be employed either for heating or after carburetting for lighting purposes. The flow

of sewage in the tank must be slow, and it should be kept in the tank for about 24 hours, so that the bacteria may have sufficient time to act on the sewage.

The effluent from a septic tank is generally dark in colour, with faecal smell and contains eggs of intestinal parasites, such as hookworms, and as such it should not be discharged into a river or a stream without further purification. It is therefore carried to either contact beds or filter beds where aerobic nitrification takes place. Here the aerobic organisms convert the different ammonia compounds into oxidised nitrogenous substances of harmless character *i.e.*, nitrates. In septic tank installation, no disinfectant should be used.

(*a*) *Contact Bed* :—It is a masonary tank and rectangular in shape and may be of any depth, but a depth of 3 to 4 feet gives the best results. Its bottom is made up of concrete and slopes from its centre to the sides, which is surrounded by a drain for collecting and carrying away the effluent. Contact bed is filled up with a layer of fine, hard, furnace clinker, quartz or gravel ranging from 1/4″ to 2″ in thickness to present a relatively large and rough surface for the growth of bacteria. The material should be removed, washed and replaced periodically.

The effluent from a septic tank, which is generally dark in colour, is distributed and allowed to remain for a fixed period generally 2-4 hours. It should not take more than half an hour to get itself filled or emptied out. It should be so arranged that each bed should be allowed rest for 8 hours after 4 hours functioning so that the bed may be properly aerated, otherwise the organisms may die.

Bacteria, chiefly aerobic, and other suspended solids adhere to the filtering media. The bacteria act on dissolved organic materials, oxidising them to nitrates. It requires some weeks for a contact bed to become efficient *i.e* to acquire a suitable bacterial flora and its useful life is from 5 to 8 years, when it becomes clogged.

(*b*) *Percolating Filter, Trickling Filter or Filter Bed* :—It works on the same principle as contact bed and is used for the same purpose although the method of application of the clarified sewage is different. In the filter, oxidation is assisted by aerobic bacterial action and the effluent is non-putrescible.

These filters are circular or rectangular in shape usually 6 feet deep and consist of a bed of porous material like *jhama*, cinder, etc., graded from above downwards, over which the effluent or clarified sewage is sprinkled through fixed sprinklers, mechanical travelling sprinklers, dripping trays etc., to ensure uniform distribution. While passing through the filter, the sewage rapidly coats the filtering medium with bacterial growth,

which is gelatinous in nature. When properly designed and worked out, these filters practically require no attention except that their surface requires scraping about once a month. It is comparatively cheaper and more efficient than a contact bed.

The final effluent is generally discharged into a river or a stream or it may be treated on the land. So when it is discharged into a river or a stream it is necessary to eliminate the danger of transmitting water borne diseases by proper disinfection. This is done by using bleaching powder or chlorine gas in some form or the other. The fluid should be clear and devoid of smell. It should be nonputrescible, having practically no suspended impurities contained in it.

(b) Activated Sludge Process or Bioaeration Process:— This is an aerobic process of disposal of sewage and is claimed to be the most satisfactory method. It is worked out on the same principle as the contact beds but a higher standard of efficiency is aimed at in this process.

The sewage is first passed through rough screens made of vertical bars fitted at a distance of about 2″ apart from each other to get rid of gross solids, such as stones, bricks, etc., from entering to the main aerating tanks. The sewage is here treated

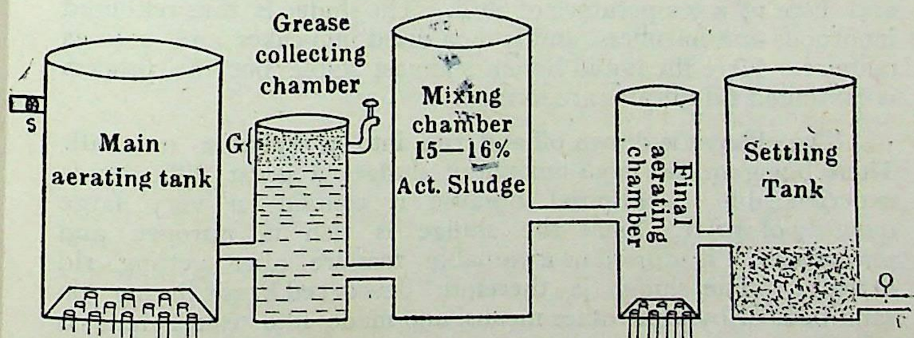


Fig. 34.—Activated Sludge process.

with compressed air, in gusts through porous tile diffusers at the bottom of the tank ; or by means of other devices such as perforated pipes, mechanical agitators or paddles. The sewage is disintegrated and liquified with formation of fine emulsion which rises at the top. Subsequently it is passed through grease collecting chamber where any grease collected at the top of the liquid is trapped.

The treated sewage is drawn off from the bottom and led into a mixing chamber. Here it is mixed intimately with 15% activated or ripened sludge, to 85% of raw sewage by thoroughly agitating. Then it is passed into final aeration chamber where

the air is forced in by diffusers, at the rate of 1-2 cubic ft. per gallon, so that it rises in the form of minute bubbles in the sewage. Practically an infinite surface of contact is produced. This is done for 6-8 hours till all the ammonia in the sewage is oxidised into nitrates. The aerobic microorganisms increase in numbers and activity and break up organic matter of the sewage till all the ammonia is oxidised into nitrates causing formation of sludge, which settles down at the bottom as a precipitate and a clear non-putrescible liquid comes over the top. The sludge which settles down is charged with microorganisms, which are carried down with it, to the bottom and is then called as *activated or ripened* sludge. Portion of this activated sludge can be used over and over again for the activation of fresh sewage. The sludge obtained from this process in inoffensive and is an anaerobic bacterial culture. It is therefore used in the process which takes place in the two stages. In the first stage the organic matter is broken down and carbon is converted into carbon dioxide. The deposit from the screening chamber is used in filling up depressions, pits etc., as it is inorganic in nature. The sludge from the primary tank and the secondary settling tank is mixed and is ripened in digesting chamber. These are circular metallic tanks which are heated by burning gas or petrol and kept at a temperature of 69°F. The sludge is thus rendered innocuous and harmless and is then dried into cakes and sold as manure. Here the liquid becomes almost stable but the process is continued till nitrates are formed.

The effluent is drawn off and run into a suitable out fall. There being an enormous amount of sludge, a great difficulty is experienced in its disposal because it contains a very large quantity of water. Since the sludge is rich in nitrogen and phosphates, it is utilised as a valuable manure after getting rid of water. The sludge is therefore dewatered by air drying on sand beds or by some other means, and made into cakes and is sold for use as a manure.

Advantages of Activated Sludge Method :—

1. The effluent is fully oxidised and is clear, being free from colloids.
2. Purification is rapid and perfect.
3. Putrefaction is quickly stopped and the system is free from the nuisance of flies.
4. The sludge is inoffensive and forms a valuable manure.
5. A small area of land is required and skilled management with a small staff can easily manage the work.

An activated sludge plant has been installed at Jamshedpur in India. It is aimed to cover a population of about one and a half lac and to purify about 5 lac gallons of sewage daily.

Characters of a Good Sewage Effluent :—

1. It should be clear, bright and free from deposit.

2. It should have no faecal smell. When a small living fish is kept in it, it should not readily die.

3. It must not contain more than 3 parts per 100,000 parts of suspended matters.

4. It must not take up more than two parts of dissolved oxygen per 100,000 parts, kept at a uniform temperature.

5. It must not contain more than 0.1 part of organic ammonia per 100,000 parts.

6. When incubated at a temperature of 80° F, in a closed vessel, for a week, it must not undergo any further decomposition.

CHAPTER VI

FOOD AND NUTRITION

The science of Nutrition deals with foodvalues, foodprocessing, its digestion, absorption and metabolism in the body. Growthdevelopment and healthpromotion in the individual, the family and the nation, depend to a major degree, on the use of the right kinds of food. Nutrition has been established as one of the most important environmental factors effecting health. A person is what he eats.

In order to understand this close relationship between food and health, it is necessary to study foodfactors and their functions. Food as a whole serves three main functions :—

(*i*) It provides the material needed for growth and upkeep of the body. Even after growth is stopped, the body continues to change throghout life. Tissues are continually wearing out, and these must be changed or repaired.

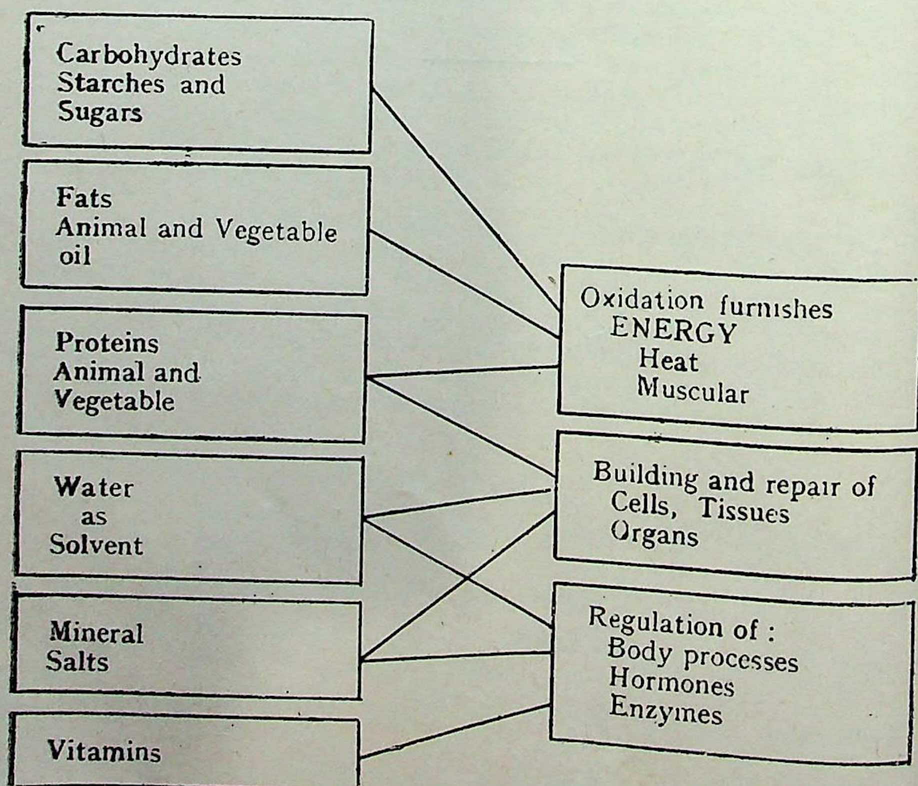


Fig. 35—Showing food factors or nutrients and their functions in the body.

(*ii*) It provides the body fuels or energyfoods, which on oxidation supply heat and work energy. Even while at bed rest, some energy is being expended on respiratory, circulatory and other body processes.

(*iii*) It provides the materials which regulate and maintain body functions and processes. They regulate the way, in which the various parts of the body act, and protect the body from disease.

Man is omnivorous. He selects his food from both animal and vegetable kingdoms since the structures and function of his body are such that it can conveniently digest and assimilate their products. A man by nature be a meat eater or vegetarian, his food consists essentially of the following six factors kown as nutrients, which are classified according to their functions.

1. Carbohydrates :—Starches and sugars are grouped under this head. Wheat, rice, maize, barley, cereals, potatoes, sweet potatoes, turnips, rootvegetables are rich in starches, while sugarcane, beetroot and fruits contain the sugars. The original source of all starches and sugars is green plants. When plants have excessive sugar and need to store it, as reserve supply of food, plant body is capable of changing the sugar into starch. Carbohydrates are abundantly present in foods. All carbohydrates have to be changed to glucose and fructose before they can be absorbed into the body. Chemically carbohydrates are composed of carbon, hydrogen and oxygen as the name implies. The carbohydrates are of three types. *Polysaccharides* or various starches which are converted into two *molecules saccharides i.e.,* cane sugar, beet sugar, milk sugar and malt sugar. These on further digestion change into single molecule *monosaccharide,* glucose and fructose.

The carbohydrates are cheap sources of energy. In the active muscles, the glucose is oxidised for the production of energy and warmth. Glucose which cannot be used immediately, is converted into glycogen and stored in the liver and muscles or converted into fat and stored under the skin.

2. Fats :—Fats are composed chemically of carbon, hydrogen and oxygen, only in different proportion to what is contained in carbohydrates. There is less of oxygen in fats than in carbohydrates. The true fats are glycerides of fatty acids. Butter, ghee, vegetable and hydrogenated oil, animal fats are examples. Fats are a form of concentrated food and like carbohydrates, they are used as body fuels for the production of heat and energy. Weight for weight fats yield more than double the heat energy, as compared to carbohydrates. As fats are not soluble in water, the process of digestion changes the fats into an emulsion form for their absorption into the body. Liquid fats and

those which melt at body temperature are somewhat better digested than those which are much harder. A fat rich diet slows the process of digestion and gives a feeling of heaviness and fulness. In the body, the fat which cannot be immediately used, is deposited as adipose tissue under the skin. Too much reserve of fat storage can hamper the action of a person's body and body organs, and thus be a real danger. Certain unsaturated fatty acids in fats are considered essential for health. Fat soluble vitamins are present in animal fats.

3. **Proteins** :—Their chemical composition is carbon, hydrogen, oxygen, nitrogen, phosphorus and sulphur. Tissues, muscles and organs, enzymes and hormones are protein in nature. For this reason, proteins are of great importance in the food. The nitrogen in the proteins, is needed for the important work of building and repairing protoplasm for body cells, tissues and organs. The body cannot store excess protein, consequently the body utilizes what it needs, and the excess protein is used as a body fuel. The nitrogen waste of this protein is excreted by the kidneys.

The proteinmolecule is very complex. It is made up of simple compounds, called aminoacids. There are 23 known amino acids each with a specific name. In the process of digestion, proteinmolecule is broken down through the stage of proteoses, peptones and peptides into aminoacids. After absorption, these aminoacids again combine to form the proteins needed by the various parts of the body. The body can synthesize more than half of these aminoacids from other forms, but there are some eight aminoacids which cannot be synthesized in the body and must be supplied readymade from food. These eight essential amino acids are :—

1. Tryptophane.
2. Lysine.
3. Methionine.
4. Threonine.
5. Phenylalanine.
6. Leucine.
7. Isoleucine.
8. Valine.

The presence of these eight essential aminoacids in adequate amount, distinguishes the animal protein as complete or first class as opposed to the generally incomplete or second class vegetable proteins, which lack in one or more of these essential aminoacids. The biological value of eggprotein is the highest; milkprotein comes next. A mixed diet containing both animal and vegetable proteins, will meet the need of essential aminoacids.

Proteinrich foods are milk, leanmeat, fish, poultry, eggs, nuts, legumes, beans and pulses.

4. **Mineral Salts** :—These form about 1/20th part of the entire body weight and are essential for the maintenance and growth of the body. They also maintain the normal osmotic pressure in the fluids and tissues of the body besides playing an important part in the acidalkali regulation of the body. The alkali forming elements are calcium, potassium, sodium, iron and manganese. The acid forming elements are phosphorous, sulphur and chlorine. The main functions of salts in the body are :—

1. To maintain tone of muscles, nerves and blood.
2. To stimulate digestive secretions.
3. To help general growth of the body.
4. To help to maintain acidalkali balance.
5. To maintain rigid structures of body such as bones, teeth etc.

The following mineral salts are most important from nutrition point of view :—1. *Calcium* :—It is the chief constituent of bones and teeth, controls rythmic activities of heart and contractile muscles. It is required in much greater amount during the periods of pregnancy and lactation. Its daily requirement for an average adult is 1 gm. and 1.5 gms. for lactating mother. Calcium metabolism is closely related to phosphorus and vitamin D. Its deficiency leads to poor development of bones and teeth, rickets, osteomalacia, delayed blood coagulation and low calcium tetany. The best sources of lime salts are milk, cheese, eggs, dark green leafy vegetables and dried beans.

2. *Phosphorus* :—It is contained in every cell of the body. It is essential for the multiplication of cells and the growth of the body It works with calcium in bones and teeth. Its daily requirement in the diet is 1.5 gms. but more of it is required during pregnancy. Its deficiency is characterised by softening of bones, stunted growth changes in the reaction of the blood and depression of vital processes Its chief sources are cheese, yolk of eggs, oatmeal, almonds, nuts, peas and beans, whole wheat, liver, milk, potatoes etc.

3. *Iron* :—It is the main constituent of haemoglobin of blood and nuclei of the cells. It is also present in the muscles and other tissues in minute quantity. It acts as an oxygen carrier to the lungs and tissues and plays an important part in the oxidation and catalysis of enzymes. Its daily requirement is 15 milligrammes. An adult man has about 3 to 3.5 gms. of iron out of which 2.4 to 2.7 gms. exist in the form of haemoglobin. Its deficiency causes anaemia. Its chief sources are liver, red meat, eggs, pulses, cereals, onions, lettuce, dried fruits, dates, figs and resins.

4. *Iodine* :—It is an essential constituent of thyroid gland. Its iodine rich secretion thyroxin, regulates the metabolism. Its daily requirement is 150 mgms. Its deficiency causes goitre. Its chief sources are seafish, codliveroil, onions and fresh vegetables.

Iodised table salt supplies the iodine in endemic goitre areas.

5. *Sodium Chloride* :—It maintains osmotic pressure in blood and other tissue fluids. It is essential for the maintenance of PH ions concentration. It forms gastricjuice and bile. Its daily requirement is 10 to 15 grams. Its deficiency leads to cramps, marked general weakness, mental lassitude, dyspnoea on exertion and heat exhaution.

6. *Copper* :—It helps in the formation of haemoglobin of blood along with iron. Its daily requirement is 2 mgm. for an adult.

7. *Chlorine* :—It is necessary to maintain the composition of blood and also in the formation of hydrochloric acid in the body. It is found in commonsalt, bananas, tomatoes, lettuce and green leafy vegetables.

5. **Vitamins** :—These are complex organic substances contained in food and are very essential for the normal growth and nutrition of animals. In fact they are vital accessory food factors and recent observations of diseases in men and experiments on animals have shown that these diseases result from deficiency in the diet of certain constituents of fresh vegetables and animal foods called vitamins. The part played by them in the metabolism is not precisely clear but some of the vitamins have been identified as components of enzyme system. They are present in various foods in minute quantities and diet devoid of vitamins, if taken for some period gives rise to certain diseases known as deficiency diseases and may ultimately even cause death. They do not supply energy but are simple protective foods. The number of vitamins generally accepted is increasing from year to year but at present only six need be considered in relation to nutrition of man.

Amounts of vitamins are generally measured in terms of International Units (I. U.). This unit is not the same for all vitamins but is in accordance with a standard laid down by the League of Nations before 2nd world war.

Classification of Vitamins —The vitamins may be classified as follows :—

A.—Fat soluble.
B.—Water soluble.

A.—Fat Soluble Vitamins :—They are :—1. *Vitamin A or fat Soluble A* :—It is essential for maintaining the integrity of the epithelial linings throughout the body for new cellgrowth and for visual purple. It is antiinfective and growthpromoting vitamin. Its deficiency causes the following effects :—

(*i*) Retards growth and lowers resistance to bacterial infection.

(*ii*) Xerosis, Xerophthalmia, or dryness and infection.
(*iii*) Nightblindness.
(*iv*) Atrophy of the cells of the salivary glands and mucous membrane of the intestines.
(*v*) Dryness of skin or Keratinisation of epithelial tissues; a condition resembling "Toad skin" occurs.
(*vi*) Formation of phosphatic calculi.
(*vii*) Respiratory infections like common colds, bronchitis etc.

Provitamin A is present in abundance in the yellow pigment of plants known as *Carotene* ($C_{40}H_{56}$) which has been isolated in the pure form. Fatsoluble Vitamin A is present in milk, butter, ghee, fishfat, codliveroil, liver, kidneys, mutton, eggs and other animal fats. Carotene in green and yellow vegetables and fruits, carrots, cabbage, mangoes and papaya are rich sources. It is not stable at high temperature when the oxidation processes destroy it. But it is not destroyed by ordinary cooking, although if cooking is prolonged or if the food is exposed to air, it is destroyed. Human requirement for vitamin A is 5000 international units for adults daily, being equivalent to 1.2 microgramme of carotene.

2. *Vitamin D or Fatsoluble D or Antirachatic Vitamin* :—This is essential for the calcification of bones and teeth and prevention and cure of rickets and osteomalacia. It is thermostable *i.e.*, it withstands a high temperature uninjured. It is present in eggyolk, codliveroil, butterfat and ghee etc. *Calciferol* (C_{28} A_{43} OH) is a preparation produced by the irradiation of ergosterol with ultraviolet rays and is termed as vitamin D_2. Naturally it is produced in the skin by the action of rays of sun. A liberal supply of vitamin D to mothers during gestation and lactation renders their children less susceptible to rickets. Moreover it corrects improper balance in calcium and phosphorus intake and if necessary for their absorption. Its deficiency leads to rickets in children and osteomalacia in adults, particularly among women observing *purdah* or persons dwelling in dark houses, where sunshine is not accessible. Daily requirement of this vitamin in children and adults is 400-1000 International Units.

3. *Vitamin E or Antisterility Vitamin* :—It is also a fat soluble vitamin. It is stable to heat, light and air. It promotes reproduction. It is present in wheat, cerealembryos, green leaves of plants and in some vegetable oils. *Tocopherol*, an oil extracted from wheat germ is the most potent known source of Vitamin E. Its role in human nutrition is doubtful. Its deficiency leads to death of foetus in uterus and sterility in males and females in the lower animals.

4. *Vitamin K or Coagulation Vitamin* :—It is essential for the normal coagulation of the blood. Its sources are green leaves

spinach, cauliflower, cabbage, carrottops, oats, wheat, soyabean-oil. Animals contain little vitamin K, though small amounts are present in eggs and milk. The part of the plants which contain chlorophyll usually have the largest amount of vitamin K. Its main function is the formation of prothrombin. Its deficiency leads to hypoprothrombinemia, occurrence of haemorrhages in the skin and subcutaneous tissues of organs.

B. Water Soluble Vitamins :– These are :—*1. Vitamin B Complex* :—The term vitamin B complex now refers to all the vitamins split off from the original "vitamin B" and identified chemically or biologically. If all members of the group are absent from the diet, they produce :—

(1) Cardiovascular symptoms such as palpitation and precordial pain.

(2) Anorexia leading to complete distaste for all food and relieved by aneurin.

(3) Diminution of nerve excitability leading to perepheral neuritis hypoaesthesia and pain along the nerve trunks.

From the complex mixture the following constituents have been isolated :—

(*a*) *Vitamin* B_1 (C_{12} H_{16} N_4 OS) is sensitive to heat. It is essential for the growth and health of the body. *Aneurine hydrochloride or Thiamine* is the synthetic preparation used. The source of this vitamin is ricepolishing, yeast, wheat, cereals, pulses, eggyolk, mutton, fish, etc. It is *anti-neurotic* and its deficiency leads to beri-beri, neuritis, intestinal atony, mental depression, anaemia. It plays an important part in the utilization of carbohydrates. Nervous system and the heart are the organs which are most markedly affected on account of taking diet deficient in this vitamin. Marmite is a valuable source of this vitamin, whereas milk which is a good source of most of the essential food factors is not rich in Vitamin B_1. The daily requirement of this vitamin is 300 International Units.

(*b*) *Vitamin* B_2 *Complex* :—It is of a great value in human nutrition and is composed of Riboflavin and Nicotinic Acid. *Riboflavin* is a water soluble pigment and is found in yeast, milk, eggs, fishroe, pork and livers. It has also been synthesized and is represented by the formula—C_{17} H_{20} N_4 O_6. It is essential for the maintenance of normal fat metabolism. Ocular manifestations, chelosis and angular stomatitis are due to its deficiency, which occurs most commonly in those individuals or communities whose diet consists mainly of milled rice. The estimated daily requirement of this vitamin is about 2 mgs.

Nicotinic Acid is the factor concerned in pellagra. It is remarkably stable capable of withstanding heat, oxidation and ultra violet

light. It maintains healthy condition of skin and mucous membrane. Its sources are meat, liver, kidney, yeast, wholemeal flour, bread, green vegetables, mangoes, etc. Its deficiency leads to pellagra with diarrhoea, dermatitis, and dementia. The daily requirement is about 12 mgs.

(c) *Vitamin B_6 or Pyridoxine or Antidermatitis Vitamin* :— It is essential for normal protein metabolism. It is necessary for haemoglobin synthesis and also as an anti-dermatitis factor. It is present in rice polishing, yeast, liver, yolk of eggs, fat, peanuts and wheat germs. Its deficiency leads to muscular dystrophy, rigidity and dermatitis in rats.

(d) *Biotin, Vitamin H* :—It is related to fat and carbohydrate metabolism. Its chief sources are liver, eggs, yeast and cereals.

(e) *Folic acid, Vitamin M* :—This stimulates formation of white blood cells. It is important for haemopoietic factor. It is present in liver, yeast and leafy vegetables.

(f) *Inositol* (*Mouse Anti-alopecia factor*) :—It is associated in some way with the metabolism or transport of fat. It is important for anti-alopecia factor.

(g) *Vitamin B_{12}* (*or Antipernicious factor Anaemia factor*) :—It is derived from liver and cures pernicious anaemia in very small doses.

(h) *Para-amino-benzoic Acid* helps tissue oxidation.

2. *Vitamin C or Antiscorbutic Vitamin* :—It is chiefly present in all living tissues, fresh fruits as oranges, lemons, black currents, tomatoes, turnips, potatoes, fresh green vegetables, and meat. Amla (*phyllanthus emblica*) and country guavas are very rich sources of this vitamin. Amla is indeed one of the richest natural sources of vitamin C. It grows abundantly in Indian forests and is obtainable in almost unlimited quantities from January to April every year. The fresh juice contains nearly twenty times as much vitamin C as orange juice and a single fruit is equivalent in vitamin content to one or two oranges. It has been synthetically manufactured and termed as *ascorbic acid or cevitamic acid*. The vitamin is destroyed by prolonged heating and in preservation of fruits. It is *anti-scorbutic* vitamin. It is essential for maintaining capillary integrity and for formation of intercellular substance. It is essential for the maturation of red blood corpuscles. Its deficiency leads to scurvy, anaemia, bad teeth, offensive breath, spongy gums, loss of weight, delaying healing of wounds and haemorrhages. The average daily requirement of this vitamin is 50 mgs.

3. *Vitamin P* :—It occurs naturally along with vitamin C in fresh fruits, particularly lemons. It helps in preventing capillary permeability and its deficiency leads to purpura, spontaneous

capillary haemorrhages and infiltration of lungs resembling tuberculosis.

6. Water :—This is an important constituent of food. It represents the major portion of most food stuffs like fruits, vegetables and milk. But as these sources are insufficient to cope up with body requirements, water must be taken either plain or in the form of other beverages. Water is necessary to make up the losses caused by its excretion in breath, sweat, urine, faeces and also to renew all the various fluids and solid organs of the body, into the constitutions of which it largely enters. It serves as a vehicle for the solution and dilution of the solid foods, whereby these are more easily digested and assimilated. It is also essential for elimination of many waste products. A satisfactory daily allowance of water needed by a person is two quarts for an adult carrying on normal life. The amount of water needed by every individual generally varies depending upon the outside temperature and to the extent up to which the human body is subjected to the manual labour. The rise of temperature and humidity of air increases the necessity for intake of water. An insufficient intake of water leads to the creation of disturbance in circulation, of heat regulating mechanism and in the retention of products of metabolism. On the other hand, abundant intake of drinking water promotes the circulation of fluid and increases the activity of kidneys with free secretion of urine. Some important uses of water are :—

1. As a solvent for transportation of nutrient about the body.
2. As help in regulating body temperature through evaporation from lungs and skin.
3. As an aid in removing wastes of metabolism in the urine.
4. As an aid in functions like osmosis.

Classification of Foods :—They are classified according to their functions under the following heads :—

1. *Energy producing foods* :—These constitute fats and carbohydrates. They are also called protein sparers. Proteins also produce energy to some extent.
2. *Body building foods* :—They are proteins, minerals and water.
3. *Protecting or protective foods* :—These constitute inorganic salts and vitamins. This group also includes proteins and water.

Metabolism and Diet Requirements

The chemical changes that take place in the body cells are very complex and the sum total of all these processes is called

metabolism. This includes the breaking down or digestion of food into simple substances and their use in the cells, including the burning of fuel foods chiefly sugar with oxygen; the formation of waste products and their elimination from the body.

Metabolic Rate (M.R.) :—This term is used to express the rate at which the cells of the body work and burn sugar and oxygen. It varies in different people, depending upon their activity, (which is controlled largely by the thyroid gland) and their occupation.

The Basal Metabolic Rate :—It denotes the energy required by the body when in a state of complete mental and physical rest and when no food has been taken for 12 hours. The basal metabolic rate varies according to many factors. The larger the surface of area of the individual, the higher the rate, because most of the heat is lost through the skin. For the same reason less heat is lost in hot surroundings. The basal metabolic rate in the tropics is probably 10 per cent lower than in the temperate climates. Children have relatively higher rates than adults and males have higher rates than females. Pregnancy increases the rate due to foetal requirements. Constant exercise increases the rate apart from energy required for the exercise. Mental excitement, fevers and thyrotoxicons all increase the rate. In addition to the basal metabolic requirements the individul requirements vary according to activity e.g., a manual labourer requires more energy than a sedentary worker.

Food Calorie :—Energy is measured as heat and the unit of heat is the calorie. It is customary to express the energy value of different food materials in terms of calories. A calorie is the amount of heat required to raise the temperature of one gram of water 1° C from 15°C to 16°C.

In metabolism, a *food calorie or a kilocalorie* is the amount of that heat which is required to raise the temperature of one kilogram of water 1°C.

One large or food calorie=1000 small calories. (used in science laboratories). The calorie is taken as the unit.

It may be noted that the calorie value is not an index of its usefulness or suitability but the food must possess a biological value *i.e.*, it should supply needs of the individual at any given time.

1 gram of carbohydrate yields 4.1 calories
1 ,, ,, fat ,, 9.3 ,,
1 ,, ,, proteins ,, 4.1 ,,

Since carbohydrates and fats are completely metabolised in the body, protein is not completely oxidised. Obviously physiological heat value of one gram of protein is less than the heat

produced, when it is fully oxidised in the calorimeter used for determining the caloric value of food stuffs.

Quantity of food required :--An average man at rest spends about 2000 calories per day, so a diet yielding 2600 calories should be taken daily by such a person. Those who do a lot of muscular work *e.g.*, farmers, manual workers etc., need up to 4000 calories, and those who do sedentary occupation for 16 hours and remaining in bed for 8 hours need 2170 calories per day. The amount of food necessary depends upon various factors such as weight, amount of muscular work done, age, sex, climate etc., Each of us requires so many calories for each pound of our weight. If real manual labourers are excluded, this will work out 16 to 24 calories for men and 12 to 20 calories for women per pound weight.

Man value and family coefficient :—In mixed population variation in age, sex, height, constitution and work are to be considered. The standard male individual is taken as one unit and the woman as 0.90 unit.

Family coefficient :—It is the relative energy requirement of various members of a household in terms of such units expressed as manvalue. Hence by man value is meant the relative energy requirement of various individuals, taking an average adult man as one unit. Different fractions for different members of the family expressed in comparison to the unit is known as family co-efficient.

Scale of Average Caloric Requirements in India :—According to Health Bulletin No. 23 the scale of coefficient and caloric requirements is as follows :—

	Coefficient	Calories required
Adult male	1.0	2600
Adult female	0.9	2100
Pregnant woman	1.2	2600
Nursing mother	1.5	3000
Child 12 to 13 years	0.8	2400
,, 10 to 11 ,,	0.7	1800
,, 8 to 9 ,,	0.6	1600
,, 6 to 7 ,,	0.5	1300
,, 4 to 5 ,,	0.4	1000

Additional Caloric Requirements :—

Type of work	Calories required per hour of Work	Example
Light	0–75	Domestic work, clerical work
Moderate	75–150	Agriculture work
Heavy	150–300	Sawing
Very Heavy	300 and upward	Sports, digging etc.

Balanced Diet :—This should contain all the food factors in suitable proportion to produce the necessary calories and to supply material for growth and maintenace to the body system without being bulky or unduly big in size. The proportion of the types of food varies with age and circumstances. The fats and proteins should be derived from animal and vegetable sources, and all the different mineral salts and vitamins should be present in sufficient quantities. The food should also satisfy the taste and the desire of the person who eats the food. It should have enough roughage to promote peristalsis.

Diet (the daily intake of food) Required for Ordinary Person of an Average Size Doing Ordinary Work should consist of the following :—

Factors	*Daily Requirements*
1. Proteins	75 to 100 grams or 3 to 3.5 ozs.
2. Carbohydrates	400 to 500 ,, or 14 to 18 ozs.
3. Fats	75 to 100 ,, or 3 to 3.5 ozs.
4. Inorganic salts :—	
(i) Sodium chloride	10 to 15 gms
(ii) Phosphorus	1.5 gms.
(iii) Calcium	1 gm.
(iv) Iron	15 mgms.
(v) Iodine	150 mgms.
(vi) Copper	1.5 mgms.
5. Vitamins :—	
(i) Vitamin A	5000 I.U.
(ii) Vitamin D	1000 I.U.
(iii) Vitamin B_1	1.2 mgms.
(iv) Vitamin B_2	2.0 mgms.
(v) Nicotinic Acid	12 mgm.
(vi) Vitamin C	500 mgm.
6. Water	2 to 4 pints

Composition of a Well Balanced Diet :—The following is an example of a good Indian diet recommended by the Nutrition Advisory Committee.

For Indians : —

Mixed Diet		*Vegetarian Diet*	
Rice	8 ozs.	Rice	8 ozs.
Atta	6 ,,	Atta	6 ,,
Dal	3 ,,	Dal	4 ,,
Oil or Ghee	2 ,,	Ghee or Oil	2 ,,
		Ground nuts	1 ,,
Fish, meat or egg (three times a week)	3 ,,	Milk or Curd	10 ,,
Milk or Curd	10 ,,	Vegetables non-leafy	3 ,,

Mixed Diet		*Vegetarian Diet*	
Vegetables non-leafy	3 ozs.	Vegetables leafy	4 ozs.
Vegetables leafy	4 ,,	Root vegetables	3 ,,
Root vegetables	3 ,,	Fruits	2 ,,
Fruits seasonal	2 ,,	Sugar or Gur	2 ,,
Sugar or Gur	2 ,,	Salts & condiments to taste	
Salts & condiments to taste			

Caloric Value of Important Foods per Ounce :—

Articles of Diet		*Calories per ounce*
Atta		
Barley	...	98
Butter	...	95
Cheese	...	209
Dal	...	99
Fresh Fruits	...	96
Dry fruits	...	10
Ground nuts	...	82
Egg	...	45
Fish	...	49
Goats meat	...	25
Ghee or oil	...	40
Milk buffalo	...	232 to 252
Milk cow	...	25
Potatoes	...	18
Rice	...	16
Sugar or Gur	...	98
Vegetables	...	110
Condiments	...	10
	...	60

Composition of Principal Foods in Gms. per Ounce :—

Articles of Diet		*Proteins*	*Carbohydrates*	*Fats*	*Salt*
Atta	...	3.4	20.2		
Barley	...	3.3	19.7	0.4	3.8
Rice milled	...	2.0	22.0	0.4	3.0
Rice unmilled	...	2.4	22.2	0.1	0.5
Pulses	...	7.1	17.0	0.2	0.5
Egg	...	3.8	—	0.2	7.1
Vegetables	...	1.6	3.5	3.8	1.5
Fruits	...	1.3	5.0	0.8	—
Meat	...	5.3	—	0.8	2
Potatoes	...	0.5	6.5	3.8	—
				0.1	—

Diet for Pregnant and Lactating Mothers :—The pregnant woman has increased nutritional demands to the increased growth of her body and to supply the needs of the foetus. The nutritive

requirements of a pregnant women must be estimated on the basis of her nutritive status, weight, stage of pregnancy and daily activity. It should also afford a reserve for the period of lactation. During first three months the protein intake should be reduced as constitutional disturbances are more common during this period, which can be done by reducing meats and pulses and increasing the quantity of milk.

As such, in addition to a well balanced diet, the pregnant and nursing mothers should have a diet, which contains an adequate amount of protective foods, proteins, minerals especially iron, calcium, iodine and vitamins. A high protein intake is essential during second half of pregnancy which also promotes lactation.

In case of lactating mothers, the child gets its protein and other nutritive essentials from mother's milk. The proteins in the diet of the lactating mother should be of the highest possible biological value and should be in the form of milk, eggs, fish and meat. The demand of the infant for vitamin A and B complex is higher than that for other vitamins. The mother's diet should contain an excess of these vitamins for supply to the infant in breast's milk. Vitamin C and D are scanty in breast's milk; these should be given to the infants early in the life in the form of cod liver oil and orange juice.

A pregnant woman requires at least 2600 calories and a lactating mother 3000 calories per day.

Diet for Pregnant Mother

Item		Quantity
Atta or, Rice	...	12 ozs.
Dal	...	2.5 ozs.
Milk	...	20 ,,
Fish	...	3 ,,
Vegetables leafy	...	4 ,,
,, Root	...	2 ,,
,, non-leafy		4 ,,
Oil and ghee	...	1.5 ,,
Fruits	...	2 ,,
Sugar	...	2 ,,
Salt and condiments		1 ,,

Diet for Lactating Mother

Item		Quantity
Atta or, Rice	...	12 ozs.
Dal	...	3 ozs.
Milk	...	32 ,,
Fish	...	3 ,,
Vegetables leafy	...	4 ,,
,, Root	...	2 ,,
,, non-leafy		4 ,,
Oil and ghee	...	1.5 ,,
Fruits	...	2 ,,
Sugar	...	2 ,,
Salt and condiments		1 ,,

Diet for Infants and Children :—An adequate quantity of protein must be supplied for the building of tissues. Besides, iron should be supplied for the haemoglobin of the blood, and calcium and phosphorus for bone growth and better teeth. Calcium is also essential for the proper functioning of nervous system. An adequate amount of vitamins is also an essential part of our diet.

Milk is the best food for infants and children. Human milk furnishes practically all the nutrients required by the infants. As it is free from harmful bacteria, so gastro-intestinal disturbances are less frequent in breast fed babies. It is easily digested.

Malnutrition is more prevalent amongst artificially fed infants than among the breast fed. Improper feeding and underfeeding are the chief causes. Breast feeding should be encouraged to avoid many of the minor nutritional disturbances during infancy.

Faults of Indian diet :—A great majority of people in India and Pakistan live on diet made up mostly and sometimes almost entirely, of vegetable foodstuffs. Millions of them do not get enough of these or they get too much of some and too little of others. The consequences are that their diet has very commonly a number of serious faults : (1) The caloricvalue is frequently too low (2) The total amount of protein is often insufficient (3) Animal protein is often scanty and sometimes entirely absent. (4) The total amount of fat is frequently too low and animal fat is scanty or lacking (5) Carbohydrates, rich staples—particularly rice or wheat—frequently from 80 to 90% of whole diet, which therefore contains too much starch in proportion to other essentials (6) Deficiency of one or more of mineral elements particularly calcium and iron is frequent (7) One or more of the vitamins is frequently deficient particularly in diet, of which the staple article is polished rice or topioca or a mixture of both (8) Besides all this, the diet lacks variety. These faults, of course are found in the diet of poorer classes. But faulty diets are not peculiar to the poorer classes; they are met also amongst the well to do classes ; for prejudices, ignorance and habit often prevent the proper choice of health giving foods.

Nutritional Surveys :—These may be categorised under 4 headings :— (1) General indications (2) Growth (3) Definite clinical signs (4) Laboratory Investigations.

1. General indications :—They are :—

(a) Conditions of subcutaneous tissue.
(b) The muscular tone—Palpate for firmness.
(c) Facial expression, bright or apathetic.
(d) Alertness.
(e) Carriage-slack or slovenly.
(f) Movement—active or sluggish.
(g) Interest and attention.
(h) State of clothes and general cleanliness.

2. Growth :—This applies mainly to children and adolescents, and is determined by height and weight.

3. Dietary Deficiencies :—Definite signs of dietary deficiencies occur, particularly in tropical countries. During infection

the incidence or absence of the following should be noted :—Dry scurfy skin, mosaic skin of legs and arms, dermititis of exposed parts, scrotal dermititis, oedema, xerophthalmia, night-blindness, pigmentation of bulbar conjunctiva, Bitot's spots, angular stomatitis, spongy gums, eroded tongue, capillary fragility, signs of rickets, goitre neuritis, anaemia and ulcers.

4. **Laboratory Investigations** :—The examination of the blood and urine for vitamin deficiencies is carried out. A biochemist is needed for these investigations.

Dietary Surveys :—Preliminary surveys should be made to determine the usual types of diets consumed. Quantity dietary surveys are more important and more difficult to carry out. Typical families are selected and their co-operation is necessary. The member of each family, together with their height, weight and occupations are recorded. All food stuffs, as prepared for cooking, are noted and weighed. All food prepared for meals but wasted or given to domestic animals must also be weighed.

Thus the kind or quality of all foods actually consumed by each family is determined. These surveys are conveniently made for periods of not more than ten days. Coefficient for each child according to age are used to record the diets in man unit value.

DIGESTION OF FOOD

The function of digestion is to break down the complex large insoluble molecules of the various foods into soluble molecules which can be absorbed from the intestinal mucus membrane. Carbohydrates, fats and proteins are mainly in need of digestion. The digestive juices or enzymes find it difficult to break the cell barrier and a preliminary cooking helps in loosening or breaking the cell membranes.

The carbohydrates have to be changed into simple sugars; the fats broken down into an emulsion; and the proteins simplified into aminoacids. Part of the change is accomplished mechanically by the teeth and the muscular motion of the stomach and the intestines, but the major part is played through the chemical action of the digestive enzymes.

Digestion starts in the mouth. The teeth chew the food into small bits and mix it with saliva, with the help of tongue. Saliva, a secretion of the salivary glands, is alkaline in reaction. It moistens and lubricates the food and its enzyme ptyalin, or salivary amylase, acts on the starchy foods to partially hydrolyse the starches into two molecule sugars. There is no action on fats and proteins in the mouth.

Softened food after the action in the mouth, is swallowed into the esophagus and propelled by the wave like movements, and reaches the stomach in a series of spurts.

Digestion Table

Location in body	*Glands*	*Secretion*	*Enzymes*	*Changes*
Mouth	Salivary	Saliva (alkaline)	Salivary Amylase	Starch to Maltose Sugar
Gullet or esophagus	Mucous	Mucus		Lubricant
Stomach	Gastric	Gastric fluid (acidic)	Pepsin	Proteins to peptones
			Rennen	Coagulates casein
	Acid glands	Hydro-chloric acid		Stimulates glands. Dissolves insoluble mineral matter.
Small Intestines (a) Duodenum	Liver	Bile (alkaline)		Emulsifies fats
	Pancreas	Pancreatic fluid (alkaline)	Trypsin	Proteins to aminoacids
			Amylase	Starch to maltose sugar.
			Lipase	Fats to fatty acids & glycerine
(b) Ileum	Intestinal	Intestinal fluid (alkaline)	Maltase	Maltose to glucose
			Sucrase	Cane sugar to glucose
			Lactase	Lactose to glucose
			Erepsin	Peptones to aminoacids

The stomach is a strong muscular organ and the strong contractions mix and break down the food further. The acidity of the stomach, hydrochloric acid kills any bacteria etc., present in the food and stops the action of the alkaline saliva. The heat melts the fats. The enzyme pepsin acting in the presence of hydrochloric

acid, breaks down proteins into proteoses and peptones. A second enzyme rennen acts upon milk, causing it to curdle, an action which will aid its digestion.

Peristalsis carries, this partially digested food called chyme, after a variable time through the pyloric sphincter into the first part of the duodenum.

The alkalinity in this part of the small intestines soon overcomes the gastric acidity. The bile and the pancreatic juices are poured into this part of the duodenum from the openings of the bile duct and the pancreatic duct. Bile is partly a waste substance of the liver; it is not any enzyme, but it aids the enzymic action of the pancreatic lipase. The bile salts help to break up the droplets of fat into an emulsion. The pancreatic juice contains three enzymes—lipase for splitting fats into fatty acids; amylase for further breakdown of sugar; and trypsin to attack the partially digested proteins.

From the duodenum, the liquid food passes to small intestines by peristalsis, where digestion is completed, through the intestinal digestive enzymes. The intestinal erepsin completes the digestion of proteins into aminoacids; the maltase, lactase and sucrase act on specific sugars to break them into glucose and fructose; and the fat splitting enzyme completes the change in fats into an emulsion form.

Absorption of the dissolved and simple nutrients takes place in the small intestines. Within the small intestines are found millions of small fingerlike projections called villi, which increase the absorption area of the intestinal wall. The digested food is absorbed by osmosis into the tiny blood vessels of each villus. The fat droplets are not absorbed in this way. They are carried through lacteals via the lymphatic system to the thoracic duct and into the circulating blood.

Tough cellulose fibres do not break down and consequently pass along with other bits of undigested products into the large intestines. This bulk of undigested matter finally reaches the rectum, and at regular intervals is voided in the form of faeces.

Conditions Regarding Diet to Maintain Health :—The food should be readily digestible. It should be fresh and flavouring so as to stimulate appetite. It must not be stale, undercooked or overcooked. Articles of rod should be changed from time to time. It should be taken at regular hours. The habit of taking too much food at a time shoulp be discouraged as this results in disordered digestion and assimilation. It is always safe to leave off with an appetite. Large quantity of water should not be taken along with meals as it dilutes the gastric and other digestive juices.

Excess of Food :—When excess of food is taken, the organs concerned in the metabolic processes have too much work to do. The blood becomes surcharged with oxidisable matter. The task of excreting the excess is undertaken mainly by kidneys and the amount of work thrown on them is out of proportion to their capacity, so suboxidation and deficient excretion results. Fermentative and putrefactive processes are set up, leading to dyspeptic troubles. Some of the products of putrefaction are absorbed into the system and lead to symptoms of autointoxication which are:— Headache, foul breath, torpor and indigetion.

If an excess in the food is prolonged for some time it will cause gastrointestinal disturbances, diseases of liver, kidneys and arteries (arteriosclerosis) a general rise of blood pressure etc. It may manifest uric acid in the system. Many of these troubles result from over-eating and many lives are shortened, as man cuts his own grave by his teeth.

Insufficiency of Food of Undernutrition :—This is seen during times of scarcity of food and if continued for a long time results in loss of weight, general debility and anaemia. Taking of insufficient food leads to partial starvation and lowers the power or resistance to disease particularly to tuberculosis. In the case of children, they become dull, and easily fatigued. They do not develop properly and are retarded in growth and remain underweight. A man may recover completely from starvation if not continued for too long a period. It has been proved that one can survive abstinance of food except water for a month without much permanent harm.

Diseases Caused by Faulty Dieting and Deficiency Diseases :—

The diet can prove to be unbalanced due to any of the following causes :—

(*a*) an inadequate supply of inorganic constituents.
(*b*) an inadequate supply of proteins.
(*c*) lack of vitamins.

These troubles are as follows :—

Causes	Effects
1. Disproportionate quantities of proteins, fats and carbohydrates.	Digestive troubles.
2. Excess of proteins in diet.	Dyspepsia, albuminurea.
3. Excess of starchy and fatty foods.	Corpulence, dyspepsia and diarrhoea.
4. Protein deficiency in infancy.	Nutritional oedema, Syndrome or Kwashiorkar.

5.	Deficiency of iron.	Anaemia.
6.	Deficiency of iodine in water.	Goitre.
7.	Deficiency of vitamin A.	Xerosis, Xerophthalmia, dry skin, arrest of development, night blindness, cattarah and broncho-pneumonia.
8.	Deficiency of vitamin B_1 or Aneurine Hydrochloride	Slow growth in children, Neuritis, Beri-Beri.
9.	Deficiency of vitamin B_2 or Riboflavin.	Angular stomatitis, erosion of tongue, ocular manifestations.
10.	Deficiency of vitamin C	Scurvy.
11.	Deficiency of vitamin D	Rickets, in children, Osteomalacia, and Dental caries.
12.	Deficiency of vitamin E	Sterility.
13.	Deficiency of water.	Disturbances of circulation and heat regulating mechanism.
14.	Deficiency of tryptophanes of protein and Nicotinic acid.	Pellagra.

Cooking of Food :—It is necessary as it makes the articles of food more digestible and palatable. It would make some of the vegetable dietary articles softer, agreeable and easy to masticate, which are too hard for digestion if taken raw. Great variety in the presentation of the food can be obtained and monotony avoided. Appetite and digestion are thereby stimulated and the food is rendered more attractive to sight, taste and smell. The process of cooking helps to delay the putrefaction and decomposition of food, for cooked food keeps longer than uncooked. Certain pathogenic microorganisms with which the food may be infected are killed by cooking due to high temperature.

Effects of Cooking :— Carbohydrates like starch grains in flour, potatoes, rice, cereals etc., swell up and burst leading to the gelatinization of starch granules. The protein coagulates (as in white of an egg) and shrinks when heated. Fats, of course are not affected on moderate heating except that the solid fats liquify on application of heat and solidify again on cooling. The effect of heat on different Vitamins is different as some are destroyed on heating, while others do not.

Thorough cooking kills the cysticerci in measly beef and pork and is a valued defence against pork containing trichinella.

Vitamin D is thermostable and therefore ordinary cooking causes no loss to it, although addition of washing soda destroys this vitamin to a considerable extent. Vitamin A is not destroyed in food cooked in the absence of oxygen. Both vitamin B_1 and

B_2 show remarkable resistance to heat, provided the medium is acidic.

Vitamin C being sensitive to heat is destroyed by moderate heating. The heat stability of vitamin C depends upon the absence of oxygen and the presence of acidity. In wholepotatoes, vitamin C will withstand boiling for half an hour but in mashed and whipped potatoes it is soon destroyed. In citrus fruits and tomatojuice vitamin C is claimed to be proof to heat of processing.

The Different Methods of Cooking are :—*1. Boiling* :—It makes the food more digestible, though it becomes less tasty. A large proportion of mineral salts contained in vegetable foods being soluble in water, are lost.

2. Roasting :—It was done formerly by exposing articles directly to fire but now roasting and baking which are similar methods are done in an oven. The heat may be applied by means of coal, oil, gas or other fuels or electricity. As a method of cooking, roasting is popular in many parts of the world for roasted meat is generally readily digestible. Roasted food is more tasty. It retains all nutritive juices.

3. *Frying* :—This method, in which food is placed in hot fat or oil, is the quickest method of cooking because the melted fat is brought to a high temperature and food placed in it is quickly heated.

There are two methods of frying, shallow and deep. In the former only sufficient fat or oil is used to cover the bottom of the pan. In the latter the pan contains a large amount of fat or oil and the food is actually boiled in the fat. Unless the fat is at a high temperature it sinks into the food and renders it greasy. The food prepared in this way is not so easily digestible as it contains a large amount of oily or fatty matter, although by doing so it becomes tasty.

4. *Steaming* :—This principle is applied in cookers. It is best as it does not involve loss of any of the nutritious ingredients.

Food Poisoning :—Food may be injurious on account of the presence of:— 1. Chemicals such as metals from tins or injurious preservatives. Cheap enamelwares may contain antimony and if the enamel comes in contact with fruit, the fruitacids may dissolve the antimony and cause poisoning. The use of commercial acid containing arsenic has resulted in an epidemic of arsenical poisoning in beer drinkers.

2. Parasites or their cysts such as tape worms and muscle-worms.

3. Bacteria or their toxins.

4. Poisonous fungi such as toadstools which may be mistaken for mushrooms.

Bacterial Poisoning:—It may exhibit every grade of severity from slight indisposition to a fatal issue. It gives rise to acute gastroenteritis due to bacterial infection of articles of food and drink or toxic substances produced in the food by the bacteria having irritant effect on the gastro-intestinal mucosa. This is mainly of 3 types :— (*a*) *Infective Type* :—It is due to the growth within the body of bacteria of the salmonella group taken with the contaminated food like meat, fish, eggs, milk and stored food. The organisms responsible for this type of poisoning be longs to salmonella group are *Bacillus Entrides* (gartner's bacillus) *Bacillus Suipestifer* and *Bacillus Typhimurium*. They are nonsporing and destroyed by heat but the endotoxins are not killed by heat and can withstand a temperature of 100°C. The symptoms produced are acute gastro-intestinal irritation *i.e.* vomiting, diarrhoea, and pain in the abdomen and collapse. They appear after a definite incubation period of about 8 hours.

The *Staphylococcus* has been associated with outbreaks of foodpoisoning which have been traced to icecreams, milk, pastries, cakes etc.

(*b*) *Toxin Type* :—This is due to the ingestion of certain substances formed as a result of the multiplication of bacteria before ingestion. The Common ways in which food is infected are :—

1. Infected animals may be used for food.
2. Infected animals may excrete specific organisms to contaminate foods, which are kept unprotected.
3. Human carriers may contaminate food by handling, as they may carry infection generally *Salmonellaparatyphosus bacillus and Salmonellatyphimurium*.

The foods concerned are tinned meat or fish. Since ducks may be infected with *Bacillus Typhimurium and Bacillus Enterides*; their meat may also be infected and cause food poisoning.

(*c*) *Botulism* :—It is a sever neurologic disease caused by ingesting neurotoxins produced by the growth of *Clostridium Botulinum* in underprocessed preserved (tinned) foods, sausages, canned fruits, preserved pickles etc. The modern food processing is now a days designed to eliminate the heat resistant botulinum spores in foods and thus the disease in no longer common now. The toxin is produced in foods containing proteins and never in fresh foods, It is also caused by soil contamination of foods. The symptoms of botulism appear within 12-48 hours. The incubation period may be as short as 4 hours and as long as 3 days, depending upon the dosage, conditions of eating and severity of infection. They are chiefly nervous in character and consist of distorted

vision, diplopia, ptosis, paralysis of accommodation, dysphagia and diminished salivary secretions. Gastrointestinal symptoms may occur but are slight and transitory in nature. Constipation may result from paresis of the intestines. Death occurs in 4 to 6 days due to failure of heart or respiration.

Clostridium Welchi, another anaerobic organism causes only mild symptoms.

How to investigate an outbreak of food poisoning :—

1. Ascertain the time, when the symptoms appear after the ingestion of food. If the interval is long, then it is due to infective bacilli as they take some time to produce the toxin. If symptoms appear rapidly then the symptoms are due to pre-formed toxins.

2. Ascertain the symptoms and the number of persons affected.

3. Secure samples of foods available, which are likely to have caused the outbreak of the disease and prepare aerobic and anaerobic cultures followed by feeding and inoculation tests.

4. Conduct laboratory examination of specimen of faeces and vomit passed by the patient in acute stage.

5. Try blood taken after one week, for agglutination test with known cultures of organisms.

6. If any case proves fatal, postmortem material from the spleen, liver, small and large intestines and the kidneys should be taken and bacteriologically examined, then valuable information regarding naure of infection may be obtained.

VEGETABLE FOODS

They contain large proportion of carbohydrates and almost all the vitamins, proteins and fats. They are classified under the following heads :—

1. Cereals. 2. Pulses. 3. Roots and Tubers.
4. Green Vegetables. 5. Fruits & Nuts. 6. Fungi.

1. Cereals :—They are in the form of seeds which contain a large quantity of nutritive material condensed in a small bulk and mineral substances like phosphates of calcium, magnesium, etc., with a small amount of iron and silica. The cereals are rich nitrogenous substances, starch and cellulose but are poor in fat. The seeds are usually ground into meal, which when mixed with water forms a tenaceous mass known as dough, from which breads etc., are prepared. These cereals are relatively rich in carbohydrates and should not be used alone but they should be eaten with other foods rich in fat and proteins. As a rule they are easily absorbed.

The cereals most commonly used are :—Wheat, rice, barley, maize, millets, oats, etc.

Wheat :—It is the most important of all seeds and is extensively used over the world. It is a staple food in certain parts of India.

It contains 60–70% starch, 8–12% gluten and 15% water. The seeds have an outer envelope called pericarp, which is very hard. It is composed mainly of cellulose and mineral matter and forms about 13% of the grain.

A middle layer called endosperm or kernal consists chiefly of starch. It forms 85% of the grain.

The germ or embryo forms about 1½% of the entire grain. It is rich in protein and fat.

Flour is prepared by grinding up wheat. The whole grain is always used; so it is rarely lacking in Vitamin B_1. It is customary to reject the outer envelope. It constitutes, what is called bran, which is used for feeding animals such as horses, etc., Bran contains a very large proportion of nitrogen and fat viz. 15 and 3.5% respectively. It is rich in mineral matter and cellulose.

In Europe there is a tendency of grinding up wholeseed. When this is done, the result is not flour, but is termed as whole wheatflour. The only objection to the wholewheatflour is that the bran is indigestible, irritating and may cause diarrhoea in people having weak digestion. The removal of bran renders the flour fine in texture and white in colour, but deprives it of most of its nutritious and fatty parts. Where it can be tolerated, it is of great advantage, as it promotes evacuation of bowels. It is more nutritious than white flour.

The flour is divided into 3 portions :—

(*a*) Sujee is the coarse grain derived from the outer coat of wheat. It contains a high proportion of proteins and mineral salts and vitamin B_1.

(*b*) Atta is the next fine layer of grain. It is rich in starch.

(*c*) Maida :—It is fine white flour and is produced from the innermost layer of wheat grain. It is deficient in all vitamins.

A good quality flour should be white or yellowish in colour and must not have a musty odour, nor it should feel gritty to touch while rubbed between fingers.

If flour is not properly stored in a dry place, it is liable to become infected with moulds, which can easily be detected with naked eye.

Wheat is a 'heat producing food'; it is more suitable for cold climates or for climates that are cold during most part of the year round. It is very suitable, therefore for people who live in Northern India

and Pakistan and for them it is a strengthening food; but it is less suitable as the only cereal food in the Southern and hotter part of India.

Rice :—It is a staple food in some parts of India, as Bengal and Madras. In composition it is poorest in proteins, fats and mineral matter, out of all the cereals. Its chief constituent is starch which is in a very digestible form. It is digested within 3-4 hours. Being rich in starch it is eaten with nitrogenous and fatty substances, like pulses, fish, ghee etc., to supply the deficiency in proteins and fats. The bulkiness of rice eater's diet gives rise to two important consequences (*a*) it tends to prevent the absorption from the intestines of the proteins and vitamins contained in other foods eaten with it; as dals or pulses (*b*) it is apt to cause distension of the stomach and bowels with fermentation of their contents and the resultant indigestion and bowel complaints. This only occurs when great bulk of the diet is composed of rice. When it is eaten in less amounts as when one meal of the day consists of atta and another of rice, it constitutes an excellent food.

The outer layer or pericarp contains vitamin B_1 and its complete removal may give rise to beri-beri in rice eating population. Rice does not contain vitamin A and B.

Rice is consumed after subjecting to either handpounding or milling. The practice of hand pounding was, in vogue before the installation of mechanical devices, the sole means of treating rice for removing bran layers. Machine milling since its introduction in India, has become of increasing importance in rice industry. It has gradually but firmly ousted handmilling to a considerable extent. It is to be noted, however, that in villages of India rice is still hand pounded, but the rice prepared in the market is usually machinemilled.

When rice is dehusked, the shell is removed leaving behind the embryo attached to the rest of the grain. In machine milling, upto 75% of thiamine may be lost in the bran, but in hand pounding the loss is about 25% There is no doubt that hand pounding of rice is better than milling.

Parboiling of Rice :—This consists of soaking paddy in cold or warm water for varying lengths of time, followed by steaming till the grain becomes soft and partly or wholly cooked. The excess water is drained off and paddy is spread out to dry. Dried parboiled paddy is then husked giving a product known as par boiled rice. The grain is slightly coloured harder than the original rice grain and may possess an odour.

There are some other methods of processing rice and paddy, according to which paddy is treated so as to give products ready to be consumed without further cooking. They do not form part

of regular meals, but are constituents of between meal snacks. They enhance the palatability.

Good rice should be entire, clean, wellhusked and nonfermenting. It should be preferably from the last harvest as new rice is apt to cause indigestion and diarrhoea. Old rice is digested easily. The process of polishing removes major portion of phosphorus and considerable portion of nutrient protein, in addition to essential vitamins. The practice of washing rice before cooking removes considerable part of residual phosphorus, Best method of cooking rice is by steaming.

Rice should be stored in dry and cold rooms. If stored in hot damp godowns, it ferments, becomes mouldy and produces toxin and may cause epidemic dropsy. Rice is often preserved by mixing lime with it. When soaked in water the diseased grains show a whitish spot. Fermented rice is warm to feel.

Barley (Job) :—This is very nutritious and is characterised by its richness in mineral salts and fat but is poor in gluten, so it is unsuited for making bread. Pearl barley is used to prepare barley water which is used as a demulcent beverage for sick and infants. Malt is barley in its incipiant stage of germination.

Maize or Indian Corn :—This is used in some parts of India. It is as nutritious as wheat, and richer in fats than all cereals except oats. It contains 10% proteins, 65% carbohydrates, 5% fats, 1-2% salts and 14% water. Maize is poor in certain aminoacids such as tryptophane. It is deficient in vitamins, the antiscorbutic and antipellagra factors being absent and an exclusive use of maize may cause pellagra. It is deficient in gluten so it does not form bread easily. But this difficulty can be overcome by mixing it with milk, eggs, etc. Corn flour is maize flour which has been deprived of its peculiar flavour by a weak solution of soda.

Millet (Joar or Bajra) :—It is less nutritious than wheat, and is sometimes eaten as porridge or in the form of thick chappaties or bread. It is midway between wheat and rice so far its nutritive value is concerned.

Oats or Jao :—These are highly nutritious but are inferior to wheat. They are deficient in vitamin A and D and gluten. Oats are used as oatmeal porridge and should be eaten with plenty of milk.

2. **Pulses** :—These are mostly legumes and are richer in nitrogenous substances than other vegetable foods. Pulses include peas, beans, and lentils. The vegetable protein, which they contain is called legumin or vegetable casein, which is not so easily digestible as milk protein. Compared to meat, pulses are deficient in fat. In their fresh state they contain vitamins A, B and C, but when dried they lose vitamin C.

Pulses are used in India in the form of "*Dals*". Owing to their richness in proteins, they are called "Poor man's meat." Pulses also contain a good deal of carbohydrates but little fat. They contain salts of potash, lime and sulphur. The latter produces much flatus. Pulses, in dried state, contain no antiscorbutic properties, but if dried seeds are soaked in water for 14 hours and allowed to germinate for a day or two, they again develop vitamin C. They must not be allowed to become dry after germination or their antiscorbutic properties will disappear. Germinated pulses may be used in diet, when other antiscorbutics such as fresh meat, vegetables or fruits are not available and where no lemon juice can be obtained. Pulses produce a feeling of heaviness, being rich in purin bodies, should not be given to persons suffering from gout or rheumatism. *Kesri dal or Masoor ki dal* when taken for a long time gives rise to train of symptoms called Lathyrism, *i.e.* symptoms of spastic paraplegia of lower limbs with increased knee jerks. Decomposed pulses should not be used, otherwise they will give rise to symptoms of vomiting and purging.

Soya Bean :—It is extensively used in China and Japan. It has very high protein and fat contents, a large amount of mineral matter and almost complete absence of starch. Iron content of soya beans varies from 7 to 30 mg. per 100 gms. The protein is of good quality and easily digestible. It contains large quantities of vitamin B_1 but no vitamin C and D. A milk from soyabean is prepared, to resemble the composition of cow's milk.

3. Roots and Tubers :—These are reserves of nutriment for the use of the plant itself. They exist chiefly in the form of starch, about 80%, proteins and fats being practically absent. They are much inferior to cereals and pulses in nutritive value as they are poor in proteins. They are therefore not suitable for taking in large quantities, forming main part of any diet. They contain some mineral matters which are mainly salts of potash. The common form of tubers are carrots, potatoes, beet-root, radish, onions, arrowroot, sago and tapioca.

Potatoes are rich in carbohydrates and contain starch 22%, protein 2%, and a trace of fat (0.16%). They are a good source of vitamins B and C and contain iron and phosphorus; that is why they are universally used as wholesome and palatable dietry articles having much nutritive value. Steaming of potatoes is a better way of cooking than boiling but their peel (skin) should not be previously removed because by such removal much of the nitrogen and minerals are lost. The anti-scorbutic vitamin is destroyed by prolonged heating.

Carrots, turnips and radish contain vitamin C but they have little nutritive value. They are used as fresh vegetables.

Arrowroot, sago and tapioca are made from tubers and contain starch. Arrowroot is prepared from tubers of the plant *Maranta arundinacea*. It contains about 82% of pure starch. Sago is obtained from pith of sago plant, whereas tapioca is obtained from the tubers of *Manihot utilissina*. As they are easily digested and absorbed hence they are generally used for invalid cookery. They are also used in preparation of puddings.

4. **Green Vegetables** :—They consist of leaves, buds, young shoots, leafy stalks and often the entire plants. In composition they consist of 90% water, 2% nitrogenous substances or proteins, 4% starch and ½% fats. They contain large amount of alkaline salts which act as "buffers" and maintain the alkalinity of the blood. They supply vitamin A, B_1, B_2 and C so their inclusion is essential in an ideal dietary. Green vegetables are rich in cellulose and so add bulk and are of value in chronic constipation. So far as possible, they should be eaten raw as salad. A good rough indication of carotene content of leafy vegetables is their tenderness or say greenness. The greener the better and the fresher the better. Ordinary cooking does not destroy the carotene present in vegetables, although it is not stable at high temperatures. Dried vegetables are practically useless as they are not antiscorbutics. Green vegetables are deficient in fat, which can be made up by cooking them in oil or ghee, which adds to their taste as well. Those vegetables which are grown on soil treated with sewage water are liable to give rise to typhoid, cholera and dysentery, and may convey parasitic infection.

5. **Fruits and Nuts** :—*Fruits* :—They contain a large amount of sugar, vegetable acids and salts. According to their nutritive value fruits have been divided by Hutchison into food fruits and flavouring fruits.

Food fruits are those which afford nutriment and include bananas, dates, figs, grapes, mangoes, etc. Their nutritive value depends on the presence of carbohydrates which exist in the form of sugar and commonly known as levulose or fruit sugar. Certain fruits such as apples, lemons and oranges are rich in potassium salts, lime and magnesia and contain anti-scorbutic vitamins.

The flavouring fruits are oranges, pineapples etc. They have got no nutritive value but are used for their sweetness and flavour. They are stimulants of the appetite and of the flow of the digestive juices; their odour, sweetness and flavour adds to their value as foods. They promote healthy action of bowels and the removal of waste products from the body. They are valuable because :—

1. They are cooling and quench thirst.

2. They contain important mineral salts of potash combined with vegetable salts.
3. They have anti-scorbutic, properties being the richest sources of Vitamin C and for this reason they are included in childrens' dietary especially in bottle fed infants. They prevent scurvy.
4. They prevent constipation.

Nuts :—They differ from fruits as they have higher nutritive value, being rich in proteins and fats. They are not easily digested as they contain much cellulose. Nuts contain less carbohydrates and are better suited for diabetics. They are rich in vitamin B but contain very little vitamin A and no vitamin C. Their composition is 15–20% proteins, 50–60% fats, 9–12% carbohydrates, 3–5% cellulose, 10% mineral salts and 5% water. Evidently their biological value is so great that they can be conveniently used as a substitute for meat.

Animal Foods

These include meat of any kind, fish, eggs, milk and its preparations etc.

Meat :—It consists of musclefibres held together by connective tissues. The fibres of the meat contain muscleplasma or musclejuice. It contains salts which are chiefly chlorides and phosphates of potash. The proteins of meat are myosin, muscle-albumin and haemoglobin. Fat is often embedded in the connective tissues of the meat.

To prevent the sale of unsound meat it is necessary that the animals be inspected before slaughtering and subsequently also the carcases. It is generally done by a veterinary expert employed by local bodies at slaughter houses, which should be public and never private.

In order that the slaughter houses be kept clean, they should have pucca cemented floors with a central drain sloping to the centre to carry off the washings. This drain should end outside the slaughter house in an iron spout, which should open in a removable receptacle or a crawley cart. The skins, hoofs and other parts which are not eaten but used otherwise, must be removed before they become a nuisance.

The following precautions should be taken in connection with slaughtering and the sale of meat, etc.

1. No person suffering from an infectious disease should be permitted to slaughter animals, meant for use as human food.

2. Some descriptive mark should be put on the carcases which have been inspected and found fit.

3. Arrangement should be made to frame rules and bye-laws for the protection of meat in the stalls from contamination by flies, cleanliness of counters and their minimum height above the counters, etc.

4. Vehicles and receptacles used for the transport of meat should be kept scrupulously clean.

Chief Signs of Illness in Animals :—They are :—

1. Emaciation, with loss of appetite.
2. Respiration rapid and difficult ; offensive odour from its breath.
3. Head hanging, movements slow, disinclination or inability to rise.
4. In febrile conditions the ears and feet are hot.
5. Loss of gloss in coat ; hairs stand out and are not smooth.
6. Nostrils are dry, covered with abnormal frothy discharge.
7. Eyes are dull or watering or congested.
8. Tongue furred and protruded. Breath may have offensive smell.
9. Blown abdomen.
10. Diarrhoea or abnormal dung stained with blood or mucus.

The animals should not be too old or too young. Animals who have come from long distances and are tired should not be slaughtered as sarcolactic acid appears in their muscles. They must be allowed to rest for a few days and kept under observation, where they are fed and have abundant water to drink. To avoid cruelty to animals pregnant animals should not be slaughtered.

In England slaughter of animals in the slaughter houses is controlled by an act called Slaughter of Animals Act 1933. Some of its principal provisions are :—

1. So far as possible, except pigs etc., animals must be slaughtered instantaneously by means of a mechanically operated instrument or they should be stunned before slaughtering.

2. Special provisions are made for stunning, when animals are slaughtered by Jewish or Mohammadan method.

Inspection of Meat :—Antemortem inspection of animals should be done, whereever possible and the carcase should be inspected after slaughtering as a whole and also part by part and subsequently organ by organ.

Characters of Good Meat :—The muscle fibres are of deep red colour and marbelled with fat. The reaction should be acidic. It should be firm and elastic to touch and there should not be excess of fluid which indicates oedema. It should have little or no odour as diseased meat will emit odour of putrefaction or

sickly smell. The fat should be firm and of yellowish grey colour. Lymphatic glands should be free from all diseases. Any diseased condition *i.e.*, cysts of tapeworm etc., should not be present.

Unsound Meat :—It is that meat which has begun to putrefy. It becomes soft, moist and pale and often has greenish colour. The reaction becomes alkaline and odour of putrefaction may commence in the deeper part of the meat especially near the bone and so the odour may not be apparent. Therefore, in case of a suspected meat, it is advisable to push an iron skewer right into the meat ; pull it out and smell it. Putrefied meat is extremely dangerous, as poisonous substances get developed, which introduce sudden and fatal illnesses due to ptomaine poisoning.

Symptoms of Ptomaine Poisoning :—They are vomiting, abdominal pain, diarrhoea, colic, cramps, severe prostration and death. It is believed that ptomaine developes in bad meat and fish. These microorganisms produce poisons in the bodies of the persons who have taken it. Presence of *Bacillus Gaertner* has been associated in several outbreaks.

Diseased Meat :—The flesh of animals suffering from diseases such as anthrax, rabies, glanders, general tuberculosis, should be condemned, together with those animals killed by accidents and lightening. The diseased meat should be selected and prevented from sending into the market.

The chief diseases are :—

1. *Tuberculosis* :—It is practically common in cattle and pigs in the European countries. It is rare in sheep, goats and other cattle in India. It is practically always present in lymphatic glands. On pleura it produces shiny deposits like bunch of pearls, while in lymphatic glands it produces lumps of cheesy material. Muscles practically never get affected and it is extremely doubtful if eating meat so affected, spreads tuberculosis.

In tubercular animals when disease is generalised, the whole carcase should be condemned as unfit for human consumption as meat is likely to be poor in quality and unwholesome even if it does not convey tuberculosis.

The following are the recommendations of the Royal Commission on Tuberculosis as a guide to meat inspectors :—

I. The entire carcase and all the organs may be seized and destroyed :—

(a) When there is miliary tuberculosis of both the lungs.

(b) When the tuberculosis lesions have been extended to

muscular system or in the lymphatic glands embeded in or between the muscles.

(c) When tuberculosis lesions are present on the pleura and peritoneum.

(d) When tuberculosis lesions are present in any part of an emaciated carcase.

II. The carcase if otherwise healthy, should not be condemned, but every part of it containing tubercular lesions should be seized and condemned :—

(a) When the lesions are confined to the lungs and thoracic lymphatic glands.

(b) When the lesions are confined to the liver.

(c) When the lesions are confined to the pharyngeal lymphatic glands.

(d) Any combination of the foregoing.

2. *Cysticercous* :—This is the name given to the embryos of tapeworm which live in muscles of animals especially oxen and pigs, where they produce little greyish bladders or vesicles called cysts. In these little cysts are contained the heads of tapeworms and when people eat such meat, these cysts break into their stomachs and let loose the heads, which pass through the intestines and fix to the intestinal wall and grow into full grown tapeworms which may be several yards long. If meat is properly cooked, the little embryos are killed then it may not do much harm. All such infected meats should be condemned.

3. *Trichinella Spiralis* :—It reaches man on account of eating insufficiently cooked flesh of pig having worms in encysted form. These, in pork and ham, may be seen as white spots, large enough to be visible to the naked eye. The adult worm lives in crypts in mucosa of small intestine. It gives rise to embroys which enter circulation and are carried into the musculature of host, where they encyst. The muscles most often affected are those of diaphragm, larynx, tongue and abdomen. Encysted larvae remain alive for years. When these cysts are found in the slaughtered animal, whole carcase should be condemned. Serious illness may result from Trichinosis whose symptoms are pain, nausea, rapid pulse, fever, irregularity of bowels and death occurring due to peritonitis. When embryos reach muscles they give rise to pain, tenderness, swelling and if laryngeal passages are involved they may cause loss of voice.

4. *Actinomycosis or Ray Fungus*—It is now recognised as a parasite which occurs in the meat of oxen. It may affect other cattle especially calves and pigs, horses, sheep etc. It occurs particularly in wet weather. The tongue, jaws and lungs are commonly affected. The postmortem appearances closely

resemble tuberculosis. In it, only the affected parts are condemned.

5. *Distomum Hepaticum or Liver Flukes* :—They resemble flatfish, each of them being 2-4 cm., long and 1 cm. wide. They are brownish in colour and are found covered with little bristles. They are very common in the sheep in India. The parasites are found in the liver and the bileducts and give rise to disease called the *rot*. As cooking always kills the fluke only a few cases of disease from this parasite are known in man.

Preservation of Meat :—Meat is preserved in the following ways :—*1. Drying* :—Meat is cut in pieces and dried by either roller processes or under reduced pressure (vacuum dried). Minced meat is easier to dry successfully than larger pieces. Loss of water inhibits putrefaction. In the fish trade, the method is principally employed for conserving of haddock. They are stored afterwards in dry atmosphere or in airtight tins.

2. *Smoking* :—Carcases of meat are salted and then hung up in a big hall and exposed to smoke produced from sawdust. Here preservation is due not only to drying but also to a large number of compounds present in smoke. The principal of these is creosote which kills bacteria and even spores.

3. *Salting or Pickling* :—Meat must be free from disease, perfectly fresh and sound before being treated. It is smeared with salt or pickled in brine, which consists of a mixture of saltpetre 1 part, salt 32 parts and sugar 2 parts. It is left soaking in it for 7 days. It is generally done in curing of bacon. It may be noted that salting indicates only a superficial preservation for a shorter time, while in pickling complete penetration of meat with the salt is obtained.

4. *Cold* :—Since cold prevents the growth and multiplication of bacteria, so considerable quantities of frozen meat are exported from Australia and America, in ships fitted with refrigeration plants. Laying of meat on ice is the simplest method of application of cold. But it should be rejected particularly when the meat is placed directly on natural ice, as there is always an apprehension of pathogenic bacteria which might be contained in the ice getting transmitted into the meat. Moreover, through the melting of ice unnecessary moisture may be added to the meat.

5. *Heat* :—It is used in the process of canning. This is the best method of preserving food. First of all the food is boiled, then sterilised and effectively sealed to prevent contamination. In the process of canning Vitamin C is destroyed.

6. *Chemicals* :—Some chemicals are used for the preservation of meat, but their use should be avoided. The common preserva-

tives used are boric acid, benzoic acid, formaldehydes, salicylic acid, sulphates, hydrogen peroxide, sodium bicarbonate, arsenic, sodium and potassium nitrate etc.

Fish :—Fish is much used in certain parts of India. It has a very high nutritive value, though not so stimulating as meat, but generally it is less rich in fats and contains more calcium than ordinary meat. It has all the vitamins except vitamin C.

There are two kinds of fish, *viz*:—*Lean fish* :—It consists of small fibres and contains fat below 2%. It is easily digested.

Fat fish :—It consists of medium or large fibres with fat content of 2.5% or more. It is difficult to digest.

A fish should have bright pink gills, firm glistening scales and prominent lustrous eyes. It should be firm and stiff and have elastic resistance of firmly adherent flesh. It should be free from any disagreeable odour. When held flat on hand by head, the tail should not droop. It should not feel soft or leave an impression or depressed mark when pressed by finger. Its skin should be intact and scales should not be easily detachable. If not eviscerated, a sound dead fish sinks in water.

A decaying fish has dull grey sunken eyes, grey gills, the scales become detached and characteristic putrefying smell. It may cause ptomaine poisoning. It floats in water with belly up. A putrefying fish shows dark blood or dark tarry liquid on cutting and its body becomes flaccid. A large tapeworm called *Dibothriocephalus-latus* is conveyed to man by eating insufficiently cooked fish.

Eating of crabs, oysters, lobsters, prawns and shellfish causes urticaria in some persons, or gastrointestinal irritation. Eating oysters and mussels grown in sewage contaminated water may cause typhoid or cholera infection.

Fish poisoning may occur due to toxins produced by *Cl. botulinus*. Its decomposition may give rise to ptomaine poisoning. It may be found that some persons possess idiosyncrasies especially to mussels which are said to cause poisoning by mytilo toxin. The chief symptoms produced are dyspepsia, urticaria, swelling of tongue, numbness of limbs, weak irregular pulse etc.

Tinned Meat and Fish :—This is commonly used. It is very essential to see that meat and fish in tins are wholesome and not old and putrefied. The tins should be carefully examined before consumption in the following ways :—*1. On Inspection* :—There should be no indentations, holes, soldering defects or signs of gross illusage. It should not be rusty. It should have concave ends and not be bulging or blowing out indicating putrefaction and formation of hydrogen gas in acidic medium. There should not be more than one soldered hole. A collapsed tin signifies

too much vacuum. All leaking and non-airtight tins should be condemned.

2. *On palpation* :—If putrefaction has set in and gas has formed it gives a springy feel with a sense of resistance.

3. *On percussion* :—If the note is tympanitic, it indicates unsound tin due to formation of gas, while a dull note indicates a sound tin.

4. *On shaking* :—A sound tin will produce no sound but if the contents are putrefied and are partially liquid then a loose sloppy sound will be detected.

Eggs :—A hen's egg weighs approximately 2 ozs. and consists of 10% outer covering or shell, 60% white, and 30% yolk. It is the safest of all animal foods as no infection can be transmissible through it. It is food containing all the proximate principles of food, except carbohydrates necessary for the growth and development of the body. It is a protective food containing first class proteins.

It consists of an outer shell with its interior white and yolk. The shell consists of carbonate of lime, the white is made up wholly of proteins, the chief being eggalbumen and the yolk contains less proteins and a large amount of fat ; besides, it contains lecithin, vitalin and the organic compounds of phosphorus, lime and iron. It is rich in calcium salts and antineuritic and antirachatic vitamins.

Eggs are easily digestible and are almost completely absorbed in the intestines, only 3% of residue is left. The digestibility of eggs depends upon the form in which they are eaten. The length of time taken in the stomach, in case of different forms of eggpreparations is as follows :—

2 Light boiled eggs.	1¾ hours
2 Raw eggs.	2¼ hours
2 Poached eggs cooked in butter.	2½ hours
2 Eggs hard boiled.	3 hours
2 Eggs omelette.	3 hours

Freshness of eggs can be tested (1) by holding them in a hand in front of a candle in dark. Fresh ones being more transparent in the centre and stale ones are transparent at their extremities. This process of testing the eggs is known as *Candling*.

(2) by putting them in salt solution, (2 Ozs. to a pint or 10%) fresh ones will sink whereas stale eggs will float.

Eggs can be preserved for a long time by preventing the entrance of air through their pores, by smearing the shell, when fresh with wax, gum, butter, lard, oil or sodium silicate and this process is known as *glazing*. Besides, eggs can be kept afresh for

about 2-3 months at a temperature of 32°F provided that the relative humidity of the atmosphere surrounding them is controlled to prevent the growth of moulds.

Milk :—It is a food material of special importance. It is a complete and ideal food and contains all the proximate principles of a wellbalanced diet. It forms the only diet of children upto the age of a year or so. It is the best source of calcium in diet both on account of quality and the valuable form in which it exists.

Milk contains the following proximate principles :—

1. Proteins :—3.5% of total weight, consisting of 3% Caseinogen, 0.4% Lactalbumin, and 0.1% Lactglobulin.
2. Carbohydrates :—Lactose or milksugar 4 to 5%
3. Fats :—In the form of glycerides in suspension, 3.5 to 4%. When milk is allowed to stand, fat rises to the surface as cream.
4. Vitamins :—It contains all the vitamins except vitamin E. In summer, cows if fed on grass, produce milk containing large amount of vitamins B, C and D. But in winter amount of vitamin A and D is much reduced.
5. Mineral salts :—Phosphates and chlorides of calcium, potassium and sodium. It is poor in iron
6. Enzymes:—Amylolytic, proteolytic and lypolytic.

Average composition of various milks is as follows :—

Kind of milk	*Proteins*	*Carbohydrates*	*Fats*	*Salts*	*Water*
Cow	3.5	4.8	3.7	0.7	87
Human	2.6	6.2	3.1	0.3	87
Ass	1.8	5.5	1.26	0.3	87
Goat	3.6	4.0	4.2	0.6	87

Caseinogen predominates in cow's and buffalo's milk with lactalbumin in human milk.

Ass's and goat's milk resemble human milk more closely, but fail as a substitute. Ass's milk has very little proteins and fats, and goat's milk contains too much of fats as compared to cow's milk.

Specific gravity of cow's and buffalo's milk is 1032. Lactometer was used to determine the specific gravity. It proved to be fallacious, as addition of water lowers the specific gravity and extraction of fat, before sale, increases the specific gravity. So addition of water, after extraction of fat, will not show any changewhatsoever so far lacto meter reading is concerned.

To arrive at a definite conclusion, a quantitative analysis is necessary which is done by Shimidst's Method. By this method all the fat is extracted from a known quantity of milk, by solvent ether and then the ether from this extract is allowed to evapo-

rate. This fat is completely dried and then weighed. The best method is Leffmann Beam's process.

Solids other than fat are estimated by evaporating to complete dryness a known weight of milk and then weighing total solids, subtracting the fat previously determined from percentage of solids, which gives percentage of solids other than fat.

Methods of Preservation of Milk :—These are as follows :—

1. *Boiling* :—This method is commonly adopted in Indian houses, as the boiled milk coagulates slowly as the organisms which produce lactic acid will be reduced in number. The pathogenic organisms (but not spores) will be killed. The changes which occur in milk after boiling are :— (*a*) The protein of milk is altered. Lactalbumin coagulates, if kept at 60°C for half an hour. The caseinogen becomes more digestible.

(*b*) Fat emulsion is destroyed and globules coalesce together.
(*c*) Mineral salts, such as calcium, phosphorus and magnesium are precipitated and a portion of citrate is lost.
(*d*) Vitamin C is lost and partial loss of vitamin B occurs.
(*e*) Enzymes and all microorganisms are destroyed.
(*f*) Carbon dioxide is expelled and caramelization of lactose occurs at temperature over 212°F.

2. *Sterilisation* :—This is done by raising the temperature to 100°C and then by maintaining it for 15 minutes in closed sterilised vessels. It kills all microorganisms and their spores. The disadvantage is that Vitamin C and B, are destroyed to one half and one third of their original content. The biological value of proteins is said to be but slightly reduced. It is unsuitable for feeding infants.

3. *Pasteurisation* :—This method was discovered by a French Chemist known as Louis Pasteur who initially devised a method of preventing the souring of wine or beer by means of some sort of heat treatment. In the case of milk; this is the best method of making milk safe for use as a food. It destroys any pathogenic organisms which may be present and reduces the number of lactic acid producing organisms. This is done by raising the temperature of milk to 145-150°F for half an hour and then rapidly cooling it to 55°F. This process neither destroys the enzymes, nor alters the taste, flavour and nutritive value of milk except the antiscorbutic vitamin which is destroyed at 125°F; other vitamins are not affected. There are various methods of pasteurisation *of milk*. Some of which are as follows :—*1.* "*Holder's method*" :—This is considered most satisfactory. In this method milk is kept at 145°F for 30 minutes. Subsequently milk is passed over chillers or coolers and the desired temperature of 55°F is attained. It is then bottled and sealed.

2. *"Flash method"* (or high temperature, short time method). It is done in Flash, Danish or Rotary Pasteurizers. Milk is momentarily exposed to a high temperature of 155°-160°F for a few seconds (*i.e.* 16 seconds) and then suddenly cooled to 55°F. In it the idea is to kill the microorganisms in milk. This is an American method and is not considered reliable.

3. *"Vat method"* :—Milk is treated in a double walled vat by steam to requisite temperature and kept in the vat as a holding device for half an hour. It is then cooled by allowing cold water to circulate through the double wall or coil of the vat.

Test of pasteurisation :—(phosphatase test) This is a calorimetric test to estimate the efficiency of pasteurisation. Principle of the test is destruction of phosphatase enzyme by requisite temperature of pasteurisation. If milk is treated to a lower temperature and for a shorter period, the enzyme remains in a greater percentage to give a positive test.

Method of preservation of milk by pasteurisation, although universally recommended and adopted is not without disadvantages. It, while destroys some organisms, has no effect on toxins. It, enables stale milk to be sold and leads to sanitary neglect in the production of milk. *Lacticacid bacillus* which restrains development of other organisms is killed, so milk is liable to become toxic on keeping.

4. *Drying or Desiccation* :—Milk is passed over heated rollers, where it is evaporated and a thin film is formed, which is scraped and passed through a sieve so as to reduce it to a fine powder. The milk prepared from this powder is of uniform composition, free from all dangerous organisms and is easily digested by infants, as the curd formed in their stomach is more flocculent and finely divided than that of the fresh cow's milk. The vitamin content of dried milk is variable. Vitamin C is reduced.

5. *Condensed Milk* :—Milk is usually pasteurised and is gradually heated under pressure in vacuum pans, till its watery portion is evaporated and it is reduced to 1/3rd of its original water contents. It is imported in sealed tins. It is of 4 kinds :—

	Milk fat percentage	*Milk solids percentage*
(*a*) Full cream (unsweetened)	9.0	31.0
(*b*) Full cream (sweetened)	9.0	38.0
(*c*) Skimmed (unsweetened)	—	20.0
(*d*) Skimmed (sweetened)	—	26.0

Skimmed condensed milk (sweetened and unsweetened) is not to be used for babies. It must appear on the labels of the tins.

6. *Addition of chemicals* :—The antiseptics usually used for the preservation of milk were salicylic acid, boric acid, borax, sulphurous acid, formalin and hydrogen peroxide. Their use now is prohibited by law.

Diseases Conveyed by Milk :—Milk contains bacillus lactic acid, which sours or ferments milk. If sour milk is given to children, it will give rise to vomiting, flatulence and diarrhoea. It is a common cause of infant mortality in children.

The diseases which are commonly transmitted to man by the use of contaminated milk are :—Tuberculosis, typhoid, paratyphoid, cholera, dysentery, diphtheria, malta fever, septic sore throat, scarlet fever and foot and mouth disease.

Milk, carefully and freshly collected, is sterile, but the market milk contains a large number of microorganisms derived from :—

1. Cow's teats or udder.
2. Hands of milker.
3. Dust or blowing air.
4. Vessels used.
5. From impure water used for washing cans.
6. Adulteration of milk.

Most of the organisms are harmless but some of them are pathogenic and give rise to outbreaks of epidemics. The common microorganisms are :—

1. *Tubercle Bacillus* :—It gets into the milk in the following ways :—(*a*) From the cow itself, if she is suffering from tuberculosis.

(*b*) Tubercular ulcer on teats or the udder.

(*c*) Some tubercular person coughing over milk.

(*d*) Flies conveying infection from tubercular sputum or other tubercular material.

The English Royal Commission on Tuberculosis has come to the conclusion that 30% of tuberculosis in children is caused by taking the infected milk.

The remedies are :—(*a*) Veterinary examination of cows.

(*b*) Exclusion of tubercular persons from the milk trade.

(*c*) Exclusion of flies by the provision of proper lids to receptacles and fly proof doors and windows.

(*d*) Compulsory notification of all forms of diseases of udder.

In order to eradicate bovine tuberculosis the following steps should be taken :—(*a*) Provision of open air sheds.

(*b*) Quarterly inspection of cows and performing of Tuberculin test after every six months.

(*c*) Slaughtering of all infected bovine and their partial compensation should be paid to the owners.

(*d*) Rendering bovine immune to the disease.

2. *Typhoid Bacillus* :—It may find access into milk by any of the following ways :—

(*a*) From the hands of the typhoid carriers.
(*b*) Carried from typhoid infected stools by flies.
(*c*) Contaminated water used in adulterating milk.

Remedies proposed are :—

(*a*) Exclusion of typhoid carriers from the trade.
(*b*) Proper protection from flies.
(*c*) Strict legislation and punishment for adulteration.

3. *Cholera Vibrio* :—It may find its way into milk in exactly the same way as typhoid bacillus and the remedies are also the same. In the case of cholera it often happens that attendants on cholera patients may handle milk for sale and thus directly contaminate the milk e.g., if the gowala suffers from an attack of cholera, his wife would attend upon him in removing stools, vomits, etc. Her hands will, therefore, get contaminated with the disease germs. Now she also happens to handle the milk which is sold to the public. The result will therefore, be a severe outbreak of cholera amongst the customers of the gowala.

4. *Dysentery* :—It is also spread by milk and the infection is passed on to the milk in the same way as in typhoid fever.

5. *Scarlet Fever* :—It is spread by taking infected milk. The milk in infected by the following ways :—

(*a*) Through a previous case in the dairy.
(*b*) Milk kept in the same room in which clothings or discharges of the sick are lying.
(*c*) Ulcerated teats, included by scarletinal virus in the process of milking by a mild unrecognisable ulcer, impart infection to such a milk.

6. *Malta Fever* :—It is spread by taking goat's milk. The germs get into the milk from the goat's blood. So milk is contaminated in goat's body.

Remedy :—Proper examination of all the goats or systematic boiling of all goat's milk.

Characteristics of a Milk Borne Epidemic :—The onset is sudden with an explosive outburst and declines rapidly if milk from the infected shop or dairy is stopped. The cases occur only in those houses which take milk from a particular infected shop or a dairy. The number of cases varies, but all the cases occur simultaneously. Those who boil milk for a long time do not catch the disease. Those who take more milk suffer the most. Children, being fed on milk, are more frequently attacked than adults. For the same reason the outbreaks are more common amongst rich people who drink milk more freely than the poor.

Control of Milk Supply of a Town :—This is done under the following heads :—

Collection, Storage and Distribution of Milk :—This is only of importance in case of large towns and municipalities. At present in India the arrangements are very unreliable. Nothing can be done except enforcing stringent legislation.

The herd should be subjected to inspection by a veterinary officer to ensure that the milk is not taken from diseased animal. This can be done by :—

(*a*) Compelling all producers of milk to get themselves registered.

(*b*) Their premises are to be also registered.

In children, tuberculosis is spread to a large extent by taking infected milk, so tuberculin test of animals must be performed periodically and only those, free from tuberculosis should be used. In Punjab, cattle are generally considered to be free from tuberculosis.

Cowsheds :—These should never be permitted to be constructed within the limits of towns, because :—

(*a*) The animals are nuisance to the traffic.

(*b*) The sheds are insanitary and produce nuisance from smell and provide places for breeding of flies.

(*c*) The sheds are necessarily dark and the animals do not get proper exercise, if they are stallfed.

For these reasons in towns in England, keeping of animals within certain limits of municipal boundaries is prohibited. The proper lighting and ventilation should be made the subject of legislation. This is done in England under the Dairies, Cowsheds and Milkshops Order, which provides that :—

1. All cowsheds should have plenty of light and should be provided with adequate ventilation.
2. The floor should be made of cement or other impervious material and properly sloped to a central drain.
3. The building should be occasionally whitewashed.
4. There should be a provision for a liberal supply of water for frequently washing the shed and the drain.
5. Arrangements should be made for the quick removal of dung, urine, etc.

The Milking or Collection of Milk :—1. The milker should be free from any disease whatsoever and should possess a certificate that he has not suffered from typhoidfever and that he is not a typhoid carrier, as typhoid carriers are particularly apt to transfer the bacilli to milk through their hands.

2. Before milking, he should wear an overall over his clothes and this overall should be daily changed by another which has been previously sterilised by boiling.

3. The milkman should wash his hands thoroughly with ordinary boiled water before milking the cattle.

4. The best out of all methods is milking of cattle by means of a machine, but this can only be done in case of large herds of cattle.

5. Milking may be done in cowsheds, although it is preferable to do in special milking sheds.

6. Cows should have clean udders which should be washed before milking.

7. Milk from a diseased cow, with sores on its udder or teats must be condemned.

Receptacles for Milk :—These must be kept scrupulously clean and washed thoroughly with boiling water before and after use, as remnants of milk will contain lacticacid bacilli and so tend to set up the souring or acid fermentation of the milk. They should have well fitted lids to keep off dust and flies. The sanitary pails should not have openings exceeding 8" in diameter.

After milking, one of the following two things generally happen :—

(*i*) The collected milk is sent to the towns after filling in large receptacles and then disposed off by retailsale.

(*ii*) Milk is retained and butter, cream, ghee, etc., are manufactured therefrom.

When milk is to be sent to the town for sale, the method of transport in England and in some towns in India, is to run the milk into large conical vessels having a broad base and provided with stout handles on their either sides and tight fitting locked lids.

The alternative, in the case of small dealers, would be to run the milk in a metal drum, mounted on wheels and provided with a tap. This can be drawn by animals or hand pushed to the town. When milk is dealt with locally, such a can or drum should be kept scrupulously clean and washed with boiling water before and after use.

The place where business regarding the sale of milk is done, is legally termed as a dairy. An ideal dairy must comply with the following regulations. These also apply to milk shops in towns or whereever they may be situated :—

1. It should not be in proximity to refuse heaps or other breeding places of flies.

2. Its walls must be made of cement or any other impervious material.

3. It must be well lighted *i.e.*, at least one square foot of glass for every 100 cubic feet of space.

4. It must be provided with flyproof wire gauze doors and windows to keep out flies, as flies are great mechanical carriers of pathogenic germs from faeces to the milk.

5. There must be a good and ample water supply available in the dairy.

6. No privy or latrine should be permitted under the same roof.

7. The milk be stored in proper receptacles provided with lids or covers to keep out dust. They must be kept clean and washed with boiling water after use.

8. Milk should never be taken out by means of measuring vessels, but should be run into them. They should be provided with handles and should be cleansed daily with boiling water.

9. All dairies and milk shops must be registered and should be open to inspection, as and when required.

Infant feeding :—The main food of most infants is breast milk. Human milk yields 20 calories per ounce so that an average infant in the second month, fed exclusively at the breast would require 20 ounces of milk a day, 4 ounces per feed, if it is fed 5 times in 24 hours. The breast milk secreted rarely exceeds 30 ounces per day and from 6 months onwards solid food may be supplied to provide the necessary calories. Artificially fed infants require slightly more milk, than breast fed infants. For hand fed infants under 9 months of age if cow's milk is used it should be diluted with water and milksugar should be added. The dense clotting to some extent should be avoided by adding some mucilaginous substance to the milk, such as barleywater, well-boiled and strained, which has the mechanical effect of preventing the particles of casein coming too close together and the curd thus formed is looser and is more easily attacked by digestive juices. Humanisedcow's milk is now very largely used in the feeding of infants. The principle to be observed in the humanising process is to prepare a fluid which shall have the composition of human milk, as far as the constituents are concerned, which shall also be devoid of harmful organic life. To effect this, the insoluble caseinogen of cow's milk must be reduced to the proportion present in human milk; the amount of lactose must be increased to the right proportion and the resulting mixture be pasteurised. Add one part of cow's milk to one part of water, then add one ounce of ordinary centrifugalised cream and one ounce of milksugar to every pint of diluted milk. Vitamin C in some form may be given from 2nd month onward, about 10 cc (or 2½ tea spoonful) of orange or tomato juice will usually supply this amount.

Different Designations of Milk in England :—

1. *Certified Milk* :—The milk must be derived from animals which are free from disease and tuberculin tested after every six months. The milk must be bottled immediately and must not be treated with heat. It should not contain more than 30,000 bacteria per c.c. and no *Bacillus coli* should be present in 0.1 c.c.

2. *Grade A. Milk (Tuberculin Tested)* :—The milk must be from animals, free from disease and tuberculin tested after every six months. The milk must not contain more than 200,000 bacteria per c.c. and no *Bacillus coli* in 0.01 c.c.

3. *Grade A. Milk* :—The cows should be examined every three months and the milk must not contain more than 200,000 bacteria per c.c. nor any *Bacillus coli* in 0.01 c.c.

4. *Pasteurised Milk* :—It should be pasteurised by the usual way. It should not be pasteurised more than once. It must not contain more than 100,000 bacteria per c.c. nor *Bacillus coli* in 0.01 c.c.

Derived Milks :—

1. *Standardised Milk* :—By adjusting milk in such a way that it contains 3.7% fat, by adding or subtracting the cream, as the need be.

2. *Reconstituted Milk* :—Condensed or dried milk is reconstituted to the equivalent composition of fresh milk by the addition of water and vitamin C.

3. *Homogenised Milk* :—It is so made that the fat does not separate out and does not rise to the surface, as cream on standing. The fat globules are reduced in size and the milk becomes homogeneous in consistency.

4. *Skimmed Milk* :—It is prepared by skimming of milk by hand. It usually contains 1% of milk fat. It should contain not less than 8.7% of total milk solids.

5. *Machine Skimmed Milk or Separated Milk* :—It is milk from which cream has been removed in a centrifugal machine. It contains milkfat less than hand skimmed milk but contains same amount of total solids.

Cream :—It is prepared by allowing the milk to stand so that butterfat may rise to the top and then removing the top layer. The fat or cream may be separated from milk mechanically through a centrifuge machine known as a "separator". Cream may contain about 50% of fat as against 3·5 to 5% in the milk.

Butter :—It is most nutritious and easily digestible form of all fats and is very suitable for patients suffering from phthisis or from many forms of dyspepsia. It is best for children while

they are growing and for old men when they are declining. Good butter should neither be rancid nor have an unpleasant odour. Specific gravity of butter fat is 911 to 913. Its melting point is 35.8°C. Its average composition should be :—

Water	12-15%
Fat	80-90%
Caseinogen	1 - 3%
Lactose	1%
Ash	2 - 3%
Salt and Vitamins	q.s.

Common salt is used as a preservative. The use of acid boric or borax as a preservative should be forbidden by law. Annatto, turmeric, saffron or coaltar dyes may be added as colouring agent. Butter is adulterated with other animal fats in Western countries and in India by other vegetable oils. Its chief adulterant is water. The nutrient value of adulterated butter is inferior to true butter.

Cheese :—It is a very concentrated protein food and methods of making it vary considerably. It is prepared by coagulating caseinogen of milk with rennet. The curd is removed from the whey. The cheese is then rolled and stored under conditions of controlled temperature and humidity and left to mature. The fatcontents of cheese depends whether it is made from whole milk, skimmed milk or milk to which extra cream has been added. Far from being indigestible, it is most readily dealt with by the ferments in the alimentary tract and being almost completely absorbed and is in every way an excellent food stuff. Cheese may contain tubercle bacilli unless prepared from pasteurised milk and typhoid organisms can remain viable for many weeks.

Margarine :—It may be defined as "Any article of food, whether mixed with butter or not, which resembles butter and is not milkblended butter". This is much used in Western countries. It is prepared from animal and vegetable fats. It does not contain fatsoluble vitamins A and D. Margarine is much inferior to butter and contains little fat as compared to butter. It must not contain more than 16 percent of water or 10 percent butter fat.

Ghee :—It is clarified butter and is largely used in India in place of butter. Ghee is prepared from cow's or buffalo's milk. Buffalo ghee is white in appearance, while cow's ghee has a faint yellowish tinge and has a pleasant agreeable smell. Buffaloghee contains more soluble, volatile acids. It is frequently mixed with other animal fats or banaspatin (hydrogenated vegetable oils). The principal adulterants are groundnut oil, animalfat, mohua

oil, poppy seed oil, cocoanut oil, boiled plantains, etc. In the manufacture of ghee from butter by usual methods, some 25% of Vitamin A originally present may be destroyed. Prolonged heating of ghee in an open pan may cause serious destruction of Vitamin A. It is probable that Vitamin A value of most samples of pure cow's ghee lies between 1000 to 2500 international Units per 100 gms., while that of a buffalo ghee it is usually lower. Banaspatin or hydrogenated oils do not contain any Vitamin A, unless and until they are "fortified" with this Vitamin alone or in collaboration with Vitamin D.

Banaspatin :—It is really a vegetable fat and is inferior to ordinary ghee and does not contain any vitamin. But in some of the brands synthetic vitamins A and D are added.

Lard :—It is the fat obtained from the interior of the abdomen of swine.

BEVERAGES

These are substances which enable food to be taken with pleasure and relish. They stimulate digestion. They may be divided into three categories :—

1. Aerated and Mineral waters.
2. Nonfermented Drinks as tea, coffee and cocoa.
3. Alcohols and Liquors.

1. Aerated and Mineralwaters :—Artificial mineral water are prepared by dissolving mineral salts and then charging with carbondioxide gas.

Natural mineral waters are derived from springs and contain natural ingredients and are impregnated with carbon dioxide gas.

Mineral Aerated waters have sharp pleasant taste. They help digestion and sometimes act as gastric sedatives.

2. Nonfermented Drinks :—(*a*) Tea :—It is said to be known to the Chinese nearly 1500 years ago and was later on introduced to England about 300 years ago. It consists of dried leaves 1"-2" long and ½" to 1" broad of a shrub called *Comellia thea* and contains 1 to 6% caffeine, a minute trace of theophyoline, 0.6% volatile oil and 6 to 12% tannic acid. It is used as a hot infusion. When infusion is prepared, caffeine, dissolves directly and tannic acid dissolves slowly. In the case of black tea, the leaves are first fermented for about 20-24 hours before heating just inorder to reduce the astringency due to tannic acid (tannin) which is generally present in the dry leaves in amounts of up to 15% depending upon the type of tea used. Green tea is prepared from the younger leaves which are roasted soon after gathering..

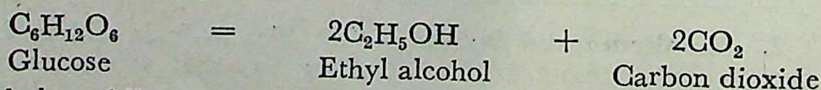
It contains more tannic acid and volatile oil and less caffeine than the black tea. In short, the flavour of tea depends on its volatile oils and the stimulating property is due to an alkaloid known as "caffeine" which may be present upto an extent of 5% in its leaves.

Excessive use of tea leads to bad digestion, as the tannin present is liable to coagulate its albuminous ingredients and thus make the food difficult to digest. It causes indigestion, insomnia and neurasthenia. In moderate quantities it acts as a stimulant and restorative.

(*b*) *Coffee* :—The roasted coffee contains 1 to 2% of caffeine, a small amount of caffeol and a large amount of tannic acid. It acts as a stimulant owing to caffeine present in it. It also contains fat, sugar, etc. It is prepared by roasting seeds of *caffea arabica* to chocolatebrown colour and then ground into powder. Its chief adulterant, particularly in French coffee, is chicory. Caffeol or the aromatic oil deteriorates rapidly on heating. It may be of interest to note that neither tea nor coffee has any calorific value, if only pure infusion is taken. Food value is attached to these beverages only when any sugar or milk are added.

(*c*) *Cocoa* :—This is a powdery preparation, prepared by roasting and grinding cocoabeans. It is nutritive as well as stimulating. It is liked by some persons as it has a palatable taste. Chocolate is a preparation of it, which is made from ripe seeds of cocoabeans after they have been sweetened, dried, roasted and deprived of their shells.

3. Alcohol and Liquors :—The term alcohol is used to cover a wide group of chemical substances but the one which is referred to under alcoholic beverages is ethyl alcohol (C_2H_5OH). It is produced by fermentation of yeast of monosacharide sugars, glucose and fructose



$$\underset{\text{Glucose}}{C_6H_{12}O_6} = \underset{\text{Ethyl alcohol}}{2C_2H_5OH} + \underset{\text{Carbon dioxide}}{2CO_2}$$

Alcohols and liquors contain from 2–50% of alcohol. They are:—

I. Beer or Malt Liquors :—Contain 3–7% alcohol. They are prepared from fermentation of malt and hops.

Cider & Perry are made by the fermentation of the sugar which is contained in the juice of the apples in the case of cider and the pears in the case of perry.

II. Spirits :—These are prepared by distillation of alcohol produced by fermentation of various saccharines or starchy materials. Some of the main varieties of spirits are :—(*a*) *Whisky*, contains 42% alcohol. It is prepared from malted barley, cereals,

rye, etc. It should not be less than two years old and should be free from disagreeable smell.

(*b*) *Brandy* contains 48 to 54% alcohol. It is a distilled wine prepared from grapes. It is the least injurious form of spirit.

(*c*) *Rum* contains 50 to 60% alcohol. It is prepared from fermentation of molasses or from sugarcane.

(*d*) *Gin* is obtained by fermentation of rye and malt and flavoured with juniper berries, cardamoms and other aromatics. It contains 40-50% of alcohol.

III. Wines :—They are the result of yeast fermentation of saccharine fruit juices. e.g. grapes. No yeast is added to the liquor as in the making of beer, as yeast spores are always present in the skin of grapes. Lighter wines generally contain 10% of alcohol and the heavier upto 20 or even 25%. Since yeast spores present in the skin of grapes cease to bring about further fermentation, when the concentiation of alcohol reaches upto 15%, the higher fermentation is obtained by adding extra alcohol to the wine i.e. it is fortified. They are *claret, burgundy, sherry, portwine, champagne,* etc.

Alcohol is freely absorbed from stomach and reaches the blood stream, therefore it requires no digestion. It is a stimulant in small doses. The disadvantage is that it leads to habit formation and so shortens life. In such cases it is apt to delay digestion, give rise to degeneration of alimentary tract, gastritis, intestinal cattarh, cirrhosis of liver, kidneys, etc. It has irritant local action and acts as narcotic. Two per cent of the alcohol taken is lost by the lungs and the remaining quantity is oxidised by the tissues. After taking excessive doses it can be traced in the urine also.

Alcohol is not a food but is useful in some conditions of exhaustion or wasting diseases. It may give energy and may lead to muscular activity, but total output of work is reduced. It cannot replace protein as it does not contain any nitrogen and has no power to build tissue. It is a protein sparer and prevents tissues waste.

Fruit drinks :—When made from fresh fruits such as oranges or lemons, fruit drinks are both palatable and a valuable source of Vitamin C. If sugar is added, they provide a source of energy which is quickly absorbed into the blood stream. The so called fruit drinks made from chemical powders and some of liquid fruit drinks sold commercially have no nutritive value other than dissolved sugar, for they contain no Vitamin C.

Condiments :—They are accessory foods such as chillies, mustard, pepper, vinegar, etc. Except common salt, they have

little or no food value but they make the food more palatable and are conducive in stimulation of salivary glands. They excite the salivary, gastric and pancreatic secretions. They also improve the appearance of food. They expel flatus.

Mustard Oil :—It is extensively used in India. It enters into the dietary of most of the people, both rich and poor. It is prepared by expression of seeds of mustard. It is extensively adulterated with some form of mineral oil or argemone oil obtained from the seeds of *Argemona mexicana*. It is a weed which grows wild in jungles, even on bunds of cultivated lands. Certain unsocial elements make it their bussiness to collect argemone seed and mix it with mustard seed especially black mustard. Both are black in colour and hence an unwary customer may not easily detect adulteration, of the seed. The practice of adulteration is nefarious and dangerous to public health. This has been shown to give rise to symptoms resembling epidemic dropsy.

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CHAPTER VII

SOIL AND BUILDING SITES

The health of a locality is often influenced by the nature of the soil on which the houses are built and it has been truly said that if the site is unhealthy the dwelling cannot be healthy.

Soil is formed by the disintegration of the underlying rocks which get mixed up in due course of time with decayed animal and vegetable matters. Often the more superficial soil, consisting of decayed animal and vegetable matter, is called *mould or humus*. The depth of this layer varies at different places.

The subsoil has been derived from disintegration of rocks in the course of millions of years through the agency of water, gases, etc. The depth of this layer varies from a few feet to hundreds of feet.

Soil, in general, is loose and friable and is above the level of ground water. It contains much air in its interstices. It is like a sponge, the particles being separated from each other by channels and interstices, through which air can pass. Ordinarily these channels are full of air. When rain falls, it penetrates down into the soil. At varying depths it forms a continuous sheet of water known as groundwater. When rain falls and percolates into the soil the air is driven out. Similarly when the atmospheric temperature is raised, due to the sun or by the warmth of the house, air is sucked out of the soil.

In olden days, this ground air was supposed to be the cause of all diseases and so the movements of the ground air were closely studied.

Classification of Soils :—Soils are classified as follows :—

1. *Sandy Soils* :—These types of soils are of considerable depth and are free from organic matter. With dry ground air, these are considered as healthy soils. If the level of the subsoil water is high or the soils are shallow and lie over clay, they are considered as unhealthy soils.

2. *Clay Soils or Alluvial Soils* :—Owing to the retention of water in these soils, they are cold and damp. Alluvial soils are found in the deltas of big rivers like the Ganges.

3. *Granitic, Metamorphic and Trap Rocks* :—These are considered as healthy sites for the houses as they are dry owing to good drainage and slopy nature of the soil. Weathered granite is however an exception to this rule as it becomes softened and absorbs water.

4. *Chalk, Sandstone, Limestone and Magnesium Limestone Soils*:—As these soils are dry, they are considered as healthy soils.

5. *Gravelly Soils* :—These are the healthiest of all the soils, unless they are water-logged.

6. *Loamy Soils* :—Such type of soils are mixture of sand, clay and humus.

7. *Filled or Made Soils* :—When depressions of the ground are filled up with refuse, the resulting soil is called "Made Soil". The refuse undergoes fermentation and putrefaction with formation of certain gases and gives rise to nuisance of obnoxious smell. Such soils are not considered suitable for the construction of buildings thereupon.

Ground Water :—This is much more important than the ground air. Its depth varies greatly and is determined by the depth of the first impervious strata. If the level of ground water. for any reason, gets very high, then that particular area should be regarded as unhealthy. Two diseases, rheumatism and tuberculosis, are particularly associated with the high level of the groundwater. The maximum height fixed for the ground water is 10 feet and if that is exceeded then the area should be considered as unsuitable for building sites. The ground water affects the health in two ways :—

1. It supplies water to all the shallow wells. If it is polluted, it may give rise to diseases.

2. If its level rises, it gives rise to dampness in houses resulting in rheumatism, cattarh, neuralgia and lung troubles.

It should be remembered, however, that the presence of moisture in the soil favours the decomposition of putrefiable materials. Therefore a drysoil is comparatively cleaner and its ground air purer than in the case of a damp one.

The level of subsoil or groundwater can be lowered by launching proper engineering schemes to a safe level. Drainage may have to be carried out on a very large scale and rivers or watercourses may have to be opened up, or porous earthenware pipes, called agricultural pipes, may have to be laid on a large scale at the depth of 10 feet and through them the ground water over that level is drained away in the direction of the slope of the land.

In hot climates treeplantation has rendered the places healthy. The vegetation abstracts large quantity of water from the soil, which gets evaporated off from the green leaves. Eucalyptus trees absorb water 11 times the amount of rainfall over the area which they cover. These have been grown in many malarious districts for purpose of rendering them more healthy and the results have been very satisfactory.

The groundwater-level rises due to canal irrigation and some times may give rise to waterlogging.

Ground air :—It differs from the atmospheric air. It is generally moist and always impure and the amount of moisture depends upon the proximity of ground water to the surface of the soil. If this is a few feet deep from the surface of the ground, the air gets saturated with moisture. But the ground near the surface of the earth is in most parts of the world, moist even after a draught, owing to the capillary action of soil and evaporation taking place from the surface of the ground water.

The impurities of the ground air are due to the decomposition of various organic matters, which are washed into the soil by the rain or which are naturally present in some marshysoils. The gaseous products of decomposition are ammonia, ammonium sulphide, methane and sulphuretted hydrogen. The impurities of ground air, even in virginsoils, are shown by a great diminution in oxygen and an enormous increase in carbondioxide. In the neighbourhood of houses, the foulness of ground air is due to the animal contamination and this may be of a most dangerous type.

Leaking cesspools, sewers, drains, animal filth and possibly infected excretions pollute the water and air present in the soil. Graveyards permit decomposing animals and dead bodies to exercise a similar pollution, whilst the organic effluvia arising from "made soils" seriously imperil the health of inmates of the houses built on them. It is important that such ground air be prevented from oozing out by rendering the basements of houses impermeable.

Diseases Attributable to Soil :—The soil has been held responsible for the spread of infectious diseases such as enteric fever, cholera, amoebic dysentery and tuberculosis.

Some pathogenic germs are present in the soil which causes anthrax, tetanus, malignant oedema, etc.

Animal parasites of man are deposited in the soil which reinfect man during one of the stages of their lifecycle. The infection contracted directly from soil polluted with human excreta is chiefly hookworm.

Diarrhoea is associated with lowlying alluvial soil, where as incidence of rheumatism, cattarh and pulmonary diseases including tuberculosis are associated with dampness of soil.

HOUSES AND BUILDINGS

Before constructing a house or a building, it is most essential that a suitable and healthy site be selected for its construction. In its selection consideration should be dryness, warmth, light and air. The height of the ground water should be determined. If it is higher than 10 feet from the surface, the site should be condemned, unless the level of ground water can be

lowered by drainage. Clay and alluvial soils should be avoided as they are damp and cold. The best soils are rock and well-drained gravel. Madesoil is unsuitable as it is polluted by sewage or refuse. Places where refuse is thrown or which are situated near the trenchinggrounds or factories should be avoided. The site should not be near the marshes, paddy fields, stables, cowsheds etc.

The building should be open on the East and South to allow free passage of light and air and should be exposed to the sun.

Since trees cause evaporation and dry the ground, there should be vegetation growing near the house, but it should not be so close as to damp the house by obstructing light and air.

Construction of back to back houses should be discouraged, as cross ventilation is impossible in such houses and the rooms, are naturally dark and ill-ventilated.

Requirements and Standards of Fitness of a Good House :—A reasonably comfortable house should be free from serious dampness. It should have adequate facilities for washing and preparing food. It should be satisfactorily lighted and ventilated. It should be properly drained and provided with adequate sanitary conveniences, *e.g.* sinks etc. It should have been built on ideal ground surrounded by healthy environments. It should be in a good state of repairs. It should have a proper provision for storage of fuel and a food store. There should be provision for adequate privacy, for the individual with ample opportunities for normal family and community life. There should also be sufficient space in the sleeping rooms to minimize the dangers of contact infection.

Construction of Houses or Buildings :—This should be done on proper sanitary lines. A house should be dry, properly lighted and ventilated. The following points should be borne in mind, at the time of construction :—

Foundation :—It must always be solid and substantial, so as to sustain the combined deadload of the building and the superimposed load. It should be dug up and a bed of good cement concrete, be made to cover the whole site of the house and should extend 6″ beyond the footings of the walls on every side. The depth of the concrete should depend upon the weight of the wall, which has to be supported and in no case should be less than 18″.

Dampness of Houses :—It is caused due to 3 major causes :—

(*a*) Rising damp
(*b*) Percolating damp.
(*c*) Roof leaks.

The rising damp can be prevented by providing adequate drainage of site, concreting the surface of floor and providing damp proof courses, where as percolating damp can be prevented by covering the external walls with cement or glazed tiles or even rejointing the gaps in the brickwork with cement or any other impermeable material. Similarly roof leaks should be properly attended to, inorder to prevent moisture oozing from the roofs.

Damp proof course :—A layer of impervious material should be laid horizontally along the entire thickness of each wall above the point, where the wall leaves the earth but below the level of the floor. It imposes a barrier to the upward progress of moisture. By the capillary action the bricks absorb moisture from the soil even as far as the upper rooms and consequently make the house damp and unhealthy. The material used for this purpose must be impermeable to moisture and sufficiently strong to with-stand weight. The following material may be used :—

1. Sheet of lead.
2. A layer of asphalt 2″ thick.
3. Two layers of slates.
4. Damp proof or well tarred bricks.
5. Stones 1″ thick, made with stone chips, cement and stone dust.

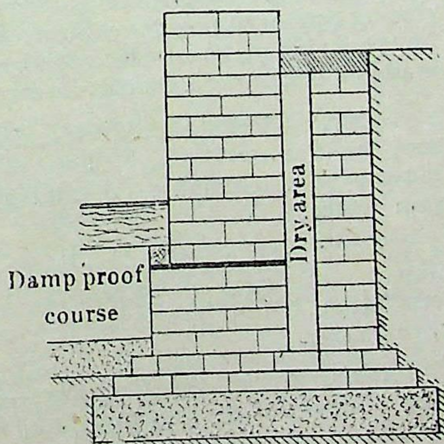


Fig. 36—Damp proof course & dry area.

In very damp marshy districts, it is advisable to raise the house above the ground on arches open to air.

Walls :—They should be constructed of bricks, stones concrete or wood. The brick walls of the houses should be dry and full of air. The bricks should be properly bounded. Ordinary bricks are porous and very absorbent. The stock size brick of 9×4½ ×3 inches is capable of absorbing as much as 16 ounces of water. Stone is non-absorbent and is least affected by changes in temperature. Timber is durable and warm but the danger of fire is a great disadvantage. Concrete is often reinforced with steel rods and ties introduced into its substance. The walls of the houses should be plastered from outside and inside. The walls in the rooms are lime washed or oil painted. The chimneys

should be constructed during erection of housewalls. They require most careful consideration in order that they may function properly. They should terminate above the highest adjoining roof.

If the wall of a house is built directly in contact with the soil, the wall is liable to get saturated with moisture from the soil. The room bounded by that wall will therefore be damped. When room is built on a cutting in a steep hill-side its lower back room happened to be damp for this reason. Similarly if a house has got a basement, it is also likely to become damp. Therefore it is necessary that there should always be an air space between such under ground walls and soil. The necessary air space is called "dry area" and must be drained below to prevent water collecting in it and it should be open above to keep the area fresh and dry.

Floors :—The base of the floor must have an impermeable layer of concrete or cement to prevent dampness rising from tbe soil below and as a valuable protection against dry rot, which is caused by the agency of a fungus, which has the effect of reducing timber to powder. Similarly the floors should be made of impermeable material which can be washed. They are generally, made of bricks, with cement concrete, glazed tiles or wood.

Roofs :—These should be sufficiently high and rainproof and may be flat or sloping. They should be provided with proper gutters with a sutiable fall and sprouts for rapid removal of rain water.

Doors and Windows :—Every room must have sufficient number of doors and windows to allow free ventilation. Cross ventilation should be encouraged. They should be provided with wire gauze.

Living-Rooms and Bedrooms :—They should be of adequate size to permit the assembly of family with comfort. They should be placed so as to secure the maximum sunlight and outlook should be pleasant as the circumstances will permit. Ventilation is of great importance. A fireplace should be provided, which forms a permanent means of ventilation.

Kitchen :—It should also be built on a detached side to prevent smoke from entering into the residential rooms. It should not be near a privy. It should be flyproof and pacca floored.

Foodstores or Larders : are essential feature of every house; they should be placed on North side wherever possible, or at any rate be protected from full heat of the sun. Good lighting and proper ventilation are indispensible and in rural area more space for food storage is desirable than in the towns.

Fuelstore :—It should be sufficient to hold adequate quantity of fuel and it should be in the same block as of the outside water closet or kitchen.

Waterclosets or Privies :—These should be built in a detached portion of the building and should be at a sufficient distance from the living room and the kitchen. There should be proper arrangement for the disposal of dryrefuse, wastewater and excreta.

Watersupply :—There should be proper arrangement of watersupply either from taps or covered deep wells.

Open Space :—There should be sufficient open space around each building. A backspace of at least 10 feet should be kept open.

Housing and Health :—Poor housing and poor health have long been associated. For more than a century, observers have pointed to this phenomenon as a basic reason for considering housing as a public health problem. It is impossible to state in definite quantitative terms exactly how much and what kinds of illness are caused by poor housing. Obviously, poor housing is only one of the factors involved in the typical health picture found in slums.

Certain diseases are more commonly seen in unsuitable homes; typhoid and paratyphoid are twice as common in houses without proper arrangement of latrines ; common communicable diseases of childhood occur more frequently and at earlier ages in crowded than in uncrowded houses ; tuberculosis, pneumonia and influenza are more prevalent. Secondary cases of tubercu- losis are 80 per cent higher in crowded than in uncrowded houses despite like incomes.

Disabling house-hold accidents are like-wise higher in poor houses. Delapidated conditions, illventilation, faulty gas con- nections and inadequate light, all contribute to it.

Standards of proper housing have recently been formulated. These standards relate to the prevention of disease and to the prolongation of life and contribute to positive health. Comfort, privacy and pride in one's home are emphasised in the modern concept of community planning.

The municipalities have framed building byelaws. The object of these byelaws is to prevent these buildings from be- coming menace to health, the safety, the welfare and the morals of the public.

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CHAPTER VIII

CLIMATOLOGY AND METEOROLOGY

Definition :—Climate may be defined as the average condition of the weather at any particular place over a considerably long period of time (Say 20 to 30 years) taking into consideration absolute extremes, means and how often these are deviated from, in the case of temperature, rainfall, atmospheric pressure, sunshine, humidity, fog, mist etc. Thus if a particular area has a heavy rainfall, it will be spoken of as having a moist climate or if it remains usually hot, it would be termed as an area having a hot climate. It depends upon the following factors :—

1. The altitude or distance from equator.
2. Distance from the sea.
3. The altitude, or height, above sealevel.
4. Prevailing winds. East and North East winds are comparatively cold, whereas South West winds are rain-bearing.
5. Amount of humidity present in the air.
6. Nature of the soil.
7. Proximity of mountains and hills.
8. Rainfall.

The human body possesses marvellous power of adaptability to various external conditions occasioned by changes of climate and season, and transition from cold to heat, dryness to humidity, and viceversa. In all cases normal temperature is maintained and bodily functions are properly performed.

Effect of Climate on Health of the People :—Climatic conditions have an important effect on health as is evidenced by the geographical distribution and seasonal prevalence of the disease. The climate is an important factor in determining the characteristics of races of mankind. It also effects in the variation of pigmentation in the skin.

Acclimatisation is effected by slow process of changes taking place either in the individual or in the race by constitutional modifications brought about by the successive generations.

Various meteorological conditions bear an important influence on climate and health.

Effects of Hot Climate on the Body :—It causes diminution of metabolism, so less amount of food is taken. It diminishes the rate of respiration, retards elimination of carbondioxide from the lungs and decreases the amount of urea in the urine. It causes reduction in the oxygenation of blood and diminution of digestive power. Moreover, due to hot climate, nerves are enervated, the skin becomes active and excretes profuse secre-

tion. Continued residence in tropical countries may bring about a languor both mental and physical, premature senility and general lowering of the expectation of life.

Effects of Cold Climate on the Body :—It causes increased metabolism, so food is taken in large quantities. Oxygenation of blood, elimination of carbon dioxide and excretion of urine are increased, the amount of sweat is reduced to minimum and the digestive power is sharpened. There is an increase in both bodily and mental activity. Cold season, we know from experience is more pleasant and invigorating and it tones up the muscles of the body. The expectation of life increases in cold climates.

Effects of Humidity on Health :—A large amount of humidity present in the air offers a check to the evaporation from the lungs and skin. It has very little drying power and therefore the moisture from the skin and the lungs is evaporated with great difficulty, thus hindering the process of perspiration and impairing normal functioning of the skin. Moist climate is less healthy than dry one, as it favours the growth and development of micro-organisms and hastens putrefactive changes. For good health, 75 per cent of humidity is best.

Effects of Warm Moist Air on the Body :— Evaporation cannot take place easily and so perspiration is not dried. It lowers the health and working efficiency to a great extent and renders one susceptible to sunstroke. There is a loss of appetite and disinclination to mental and physical work. The native races of humid tropical lands are indolent and unprogressive.

Effects of Cold and Damp Air on Health :—There is a rapid loss of heat and chilling of the body. It predisposes to the affections of respiratory passages, rheumatism, circulation and kidneys.

Effects of Warm Dry Air on Body :—A relatively dry air feels better than moist air at most temperatures. When the air is dry and warm, the rate of evaporation from the body is greatly increased.

Effects of Cold and Dry Air on the Body :—All the body functions are more active, breathing is deeper and more frequent, the circulation of the blood is increased, processes of digestion, assimilation and metabolism are stimulated. This climate is more bracing and invigorating. The skin becomes dry and chapped.

Effects of High Altitude on Climate :—There is diminished atmospheric pressure, rarefaction, and purity of air, and humidity of the air is lessened. There is considerable increase of sunlight, on account of brisk blowing of the air. Moreover, there is a large amount of ozone present in the air and it is also free from germs

and dirt. The temperature is lower. As a general rule temperature falls, about 1°F for every 300 feet of altitude or 1″ latitude, and pressure falls, about 1 lb. for every 1800 feet ascent.

A condition known as "Mountain Sickness" is considered to be due to the rarity of the atmosphere and diminution of oxygen at great heights. The symptoms are deep breathing, quick pulse, cynosis, nausea, headache, intestinal disturbances and fainting. Bleeding from the nose, ringing in the ears and palpitation of heart are not infrequent symptoms.

Effects of Residence on Health at High Altitude :—The capacity of chest is increased in all measurements with increased power of expansion and contraction. People living at high altitudes have robust health. The mountain climate is very beneficial to persons suffering from phthisis in incipient stage. Places sheltered from cold winds should be selected for residential purposes. It is also good for persons suffering from anaemia, spasmodic asthma without emphysema and chronic pleurisy. High altitude is however, bad for persons suffering from chronic bronchitis, emphysema, bronchiectasis, diseases of heart and great vessels, affections of kidneys, liver and those of the brain and spinal cord.

Effects of Increased Atmospheric Pressure on Health :—This is seen in places like mines, submarine works and bridges. There is an increased absorption of oxygen by blood. The effects known as "*Caisson's disease*" are found in the workers working in compressed air chambers. The symptoms are pain in the ears, excruciating pain in joints and muscles, vertigo, epigastric pain and vomiting. There may be appearance of headache, giddiness, epistaxis, paralysis etc. Sometimes death may occur from internal haemorrhages. These symptoms do not appear, when the men are working inside but appear rapidly when they come outside. Decreased pressure of the outside air causes sudden liberation of absorbed gases from the tissues and blood of the workers. To prevent this, decompression should be done gradually, by providing one or more locks on the exit passage.

Effects of Rainfall on Climate :—It washes down impurities and microbes contained in the air thus rendering the atmosphere, cool fresh and invigorating. It reduces the atmospheric pressure.

Effects of Vegetation on Climate :—Vegetation, in moderation improves the climate by keeping the air cool and equitable and counteracts the effects of radiation from earth.

Where there is no vegetation, as in deserts, it leads to a great variation. The deserts are very hot during the day time but temperature falls during the night very considerably owing to rapid radiation.

In cold climates, the trees and shrubs obstruct the passage of the rays of the sun falling direct to the soil, which is, therefore, liable to be cold and moist but they may prove to be of great help in protecting the place against the cold winds.

In hot climates, the evaporation of water from the leaves of the trees tends to dry the soils and lower the temperature. The ground is sheltered from the direct rays of the sun by the leaves of the trees and thus keep the place cool.

Hence the heat of summer is reduced, and the cold of winter is tempered with by the presence of trees. Places grown with trees have comparatively lower temperature than other dry places having no vegetable growth thereupon.

In very dense forests the air is generally stagnant.

METEOROLOGY

It is a science which deals with the atmospheric phenomena in relation to weather and climate.

Weather :—It denotes general condition of air at any stated period or time or more scientifically it may be defined as the state of atmosphere at any particular time in relation to its temperature visibility, humidity, precipitation or any other meteorological phenomena.

Atmospheric pressure :—It is determined by means of a barometer. The most commonly used is a *Fortin's Standard Barometer.* First the reading of the attached thermometer is noted. In this type of barometer the cistern is made of a pliable base of leather, which can be raised or lowered by means of a screw. Before taking a reading, the level of mercury in the cistern must be adjusted. A sliding vernier is also attached to it. The vernier is adjusted by means of the rack and pinion at the side of the barometer. The barometer must be fixed in a properly lighted room protected from sun and rain.

Another barometer used is *Aneroid Barometer.* It contains no mercury. It consists of a small box, which is exhausted of air and contains a series of springs. The pressure is communicated by these springs on the dial, which has been graduated by comparison with a standard mercurial barometer. When the atmospheric pressure increases, the spring is pulled down, whereas if the pressure diminishes, the spring rises up. This instrument is easy for transport and is used for recording altitudes.

Temperature :—This is ascertained by an instrument called thermometer. There are three kinds of thermometers which are commonly used. They are as follows :—

Name of thermometer	*Freezing point*	*Boiling point.*
1. Fahrenheit	32	212
2. Centigrade	0	100
3. Reaumur	0	80

Several kinds of thermometers are used in India. These are :—

1. *Standard or Dry Bulb Thermometer* :—It is an ordinary thermometer.

2. *Maximum Thermometer* :—It is used for registering the highest temperature attained in the day or any other period. The thermometer is laid in a horizontal position. In the stem of the thermometer part of the mercury column is separated by air. When the temperature rises the mercury expands and pushes this broken column forward. But this column does not recede when the temperature falls and the main mercury column contracts. The reading taken indicates the maximum temperature during the day.

3. *The Minimum Thermometer* :—It is used for recording the lowest temperature during the night or at the time of the early hours of morning. A small glass index is enclosed in the spirit, which fills the bulb and a part of the stem. When setting the instrument, the index is first brought to the top of the column of the spirit and the instrument placed in a horizontal position.

When the temperature rises, the spirit expands and flows past the index, but when the temperature falls the spirit contracts and carries the index along with it. The lowest temperature is thus registered. The instrument can be readjusted by tilting.

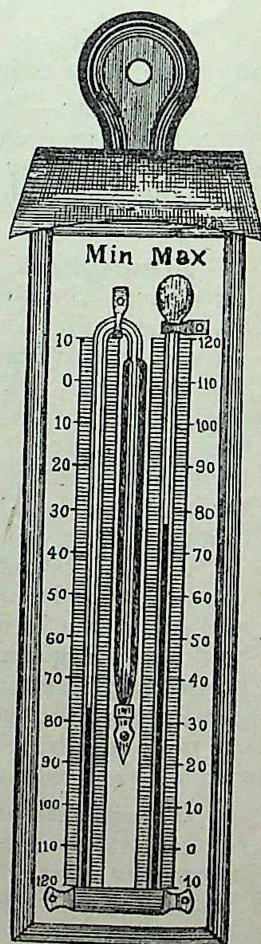


Fig.—37
Six's Thermometer

4. *Six's Maximum and Minimum Thermometer* :—It is a combination of maximum and minimum thermometers and gives a double reading. It is a U shaped tube having a bulb at each end. The middle portion of it contains mercury. Both the tubes above the mercury and one of the bulbs contains alcohol and a part of the other bulb contains alcohol vapour and air. In each stem there is an iron index which can be moved and adjusted by a magnet. With the rise of temperature, alcohol expands and pushes the mercury and with it the index also gets pushed up to the other stem. With the fall of temperature the alcohol contracts and the mercury falls, and it pushes up the index in the other column. In this

way, the highest and the lowest temperatures are recorded by the indices in the right and left limbs respectively.

5. *Solar Radiation or Vacuum Thermometer* :—It is used for measuring the intensity of heat given off or radiated by the sun. It is a mercurial self-registering thermometer having a bulb coated with lampblack to absorb the rays of the sun. The bulb is placed in a glass case in order to prevent the coating from being

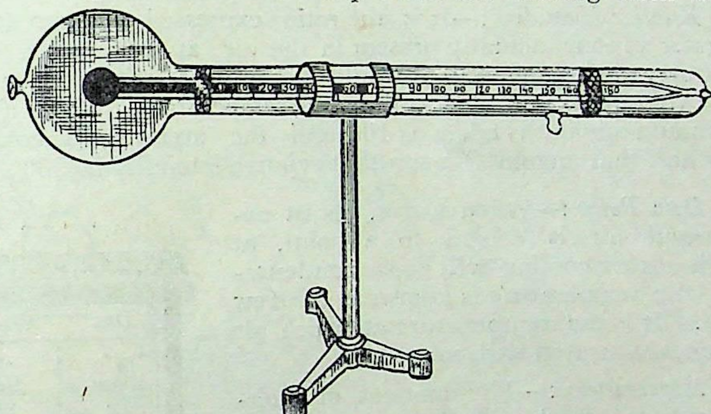


Fig. 38 – Solar Radiation or Vacuum Thermometer.

washed away by rain. The instrument is placed horizontally about 4 ft. above the ground, away from the walls and the trees, and exposed to the direct rays of the sun. The difference between the maximum temperature in the sun and in the shade is the amount of solar radiation "indicated during the day" or of the power of the rays of the sun.

6. *Terrestrial Thermometer* :—It is a minimum shade thermometer placed close to the ground, the bulb resting on the grass about 4″ above the ground. The difference between this minimum

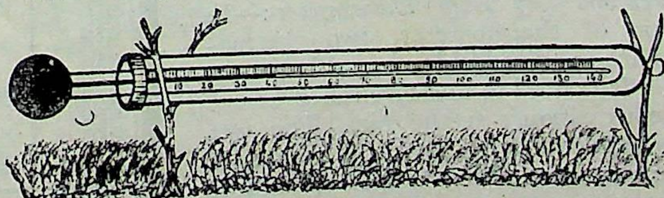


Fig. 39—Terrestrial Thermometer,

temperature and the air minimum in the shade is the amount of terrestrial radiation.

Humidity :—This denotes the amount of moisture present in the air. The air absorbs moisture by evaporation of water from the surface of ocean and other surface collections of water. The amount of water vapour absorbed by air depends on its tempera-

tur. The higher the temperature the greater is the amount of water vapour it can hold at that temperature.

Absolute Humidity :—The actual amount of moisture present in a given volume of air is called "absolute humidity". It is expressed in grammes per cubic feet *i.e.* the weight of moisture contained in a known volume of moist air.

Relative Humidity :—It is the ratio expressed as percentage of water vapours actually present in the air at any given temperature, to the amount that would be present, when the air of same volume, is saturated at the same temperature. Thus if the maximum amount is taken as 100 and the atmosphere contains only half that amount, we say that relative humidity is 50%.

Dew Point :—When warm, moist unsaturated air is cooled to a point, at which further cooling will cause condensation the temperature is known as the d ew point. It is the tempeaature at which air becomes saturated with moisture.

Hygrometers :—The amount of moisture present in the air is registered by means of hygrometers. These are of two types *i.e.* direct and indirect hygrometers. Their examples are as follows :—

1. *Direct* :—(*a*) Daniell's Hygrometer.
   (*b*) Regnault's Hygrometer.
   (*c*) Dine's Hygrometer.
2. *Indirect* :—(*a*) Wet and Dry Bulb Thermometer.
   (*b*) Psychrometer.

Wet and Dry Bulb Thermometer :—In this type of thermometer, two thermometers are mounted side by side on a stand. It is used to measure the pressure of aqueous vapours in the air. The wet bulb is kept constantly moist by means of a piece of muslin cloth wrapped around it and dipping into a small vessel containing water. This water, on evaporation, absorbs heat from the thermometer, with the result that the temperature indicated by this thermometer is much lower than that given by the dry one. The difference in the two, however, depends on the rapidity with which the evaporation pro-

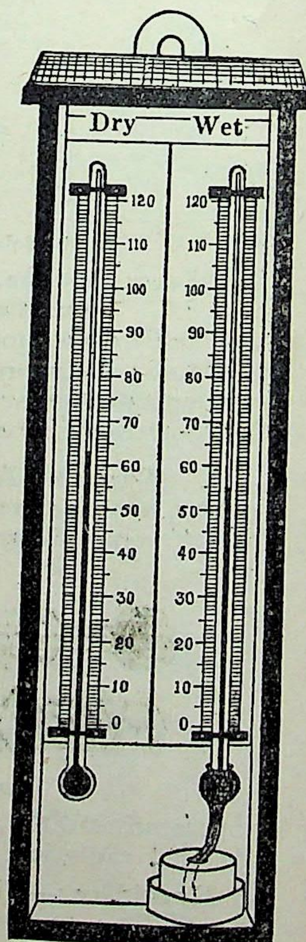


Fig. 40—Wet and dry-bulb thermometer.

ceeds and the rate of evaporation depends upon the temperature and the humidity present in the air. If the air is dry, the evaporation will be rapid and the temperature of the wet bulb will be much below than of the dry one. This difference enables one, by means of tables,to obtain the percentage of humidity, the Dew point and the vapour pressure of the air. The instrument should be kept in the shade and protected from the air currents and direct sunshine.

Kata Thermometer :—It is used to measure the cooling power of the air at a given time and place.

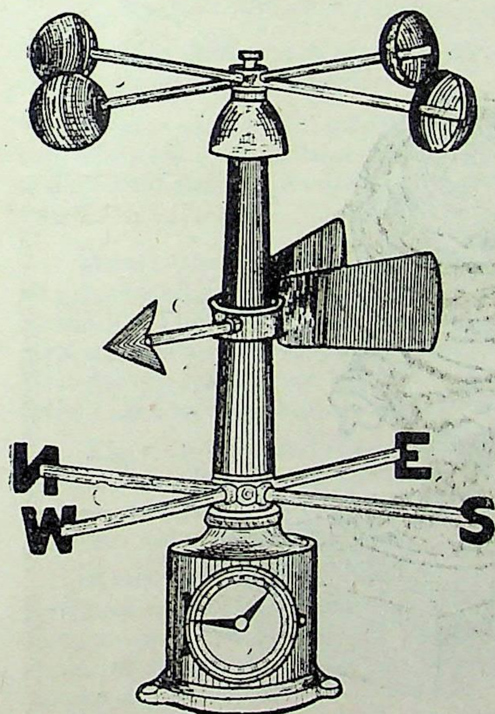


Fig. 41—Robinson's Anemometer and Weather Vane

Winds :—These are produced by the disturbance of equilibrium of the two masses of air in a freely mobile atmosphere. The causes of these disturbances are the difference in atmospheric pressure brought about by changes in temperature and moisture aided by physical and other factors of the two masses of air.

Weather Cock or Weather Vane :—It is an instrument by means of which the direction of the wind is indicated. It consists of a balanced lever, turning on a vertical axis, the broad end of which is exposed to the prevailing current of the wind while the narrower end points to the direction from which the wind may be blowing. It is fixed on highest point of the building.

Anemometer :—The pressure and velocity of winds are recorded by this instrument. These are of several varieties. One commonly used variety anemometer is Robinson's Wind Anemometer. It consists of a metal with hollow hemispheric cups fixed at their ends and revolving horizontally on a vertical axis, which by arrangement of screws, records the movements on a dial. 500 of its revolutions make up a mile. The velocity can be deduced therefrom. This instrument should be kept clean and properly oiled. It should be fixed at least 20 ft. high from

the ground. The average velocity of winds is from 6 to 8 miles per hour.

Sunshine Recorder :—The hours of bright sunshine are recorded by this instrument. Various types of sunshine recorders *viz.*, Campbell, Stokes, Mcleod's, Jordon's, Isohel's *etc.*, are available in the market. The standard type of sunshine recorder consists of a glass sphere on which the rays fall and the image is received on a strip or a millboard, at the proper focal distance and makes a burnt track when the sun shines. The sunshine should be measured in hours and tenths of an hour and not in minutes.

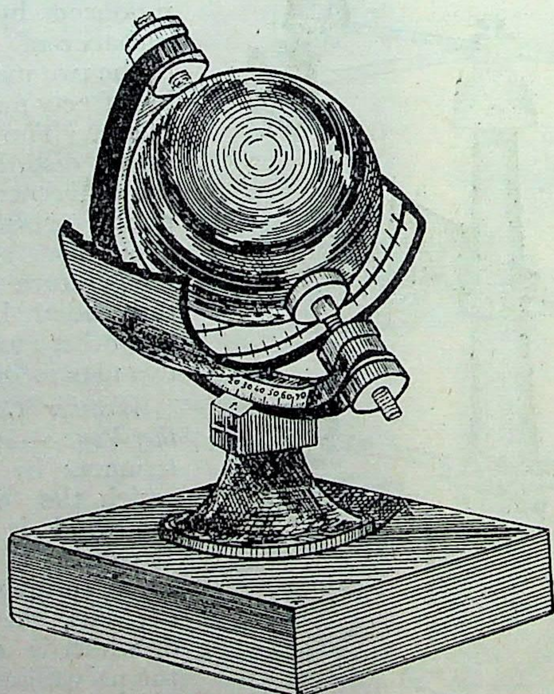


Fig. 42—Sunshine Recorder.

Clouds :—These consist of masses of vapours condensed into minute water particles which float in the air in the higher regions of atmosphere usually from one to four miles above the surface of earth.

A cloudline is the level below which the formation of clouds rarely takes place.

Classification of clouds :—

(A)—Highest clouds :—With height 9000 metres :—

1. *Cirrus* :—They are white and feathery looking. They are probably composed of small particles of ice.

2. *Cirro stratus.*

(B) Clouds of mean altitude :— With height 3000 to 7000 metres :—

1. Cumulus or heaped up masses resting on straight bands and having appearance of hills or mountains. They are most common in summer and during the day.

(C) Low clouds :—With height below 2000 metres :—

1. Stratus or horizonatal bands :—These are horizontal sheets which are seen at sunset and disappear at sunrise. They foretell fine weather. These are lowest in elevation.

2. *Nimbus* :—They are dark masses discharging rain or snow.

Besides these which are primary forms, there are several combinations of these clouds.

Mist :—It signifies suspended liquid droplets generated by condensation from gaseous state or by breaking up a liquid into a dispersed state. Generally it is spoken of as a cloud near the earth.

Dew :—In this case atmospheric moisture gets precipitated or condensed on the solid substances on the surface of the ground. The dew point denotes the temperature at which water vapour, already present in the moisture, is the maximum quantity, the air can hold or in other words it is the temperature at which air becomes saturated with moisture.

Fog :—It is a cloud resting on the earth and occurs when the surface of the ground is warmer than the air in contact with it. The hot air rises to be condensed into fog.

Rainfall :—Rain is the result of moisture condensing and coalescing to form drops of water and the rainfall includes all moisture falling in particulate drops. This is measured by an instrument called Rain Gauge which consists of a copper funnel leading to a receiver made of glass. The funnel has a sharp rim and usually five inches in diameter. The rain having been collected in the receiver, is measured in a glass cylinder, which is graduated to correspond with 1/100th of an inch of rainfall. The reading is generally taken at 9 A.M. daily.

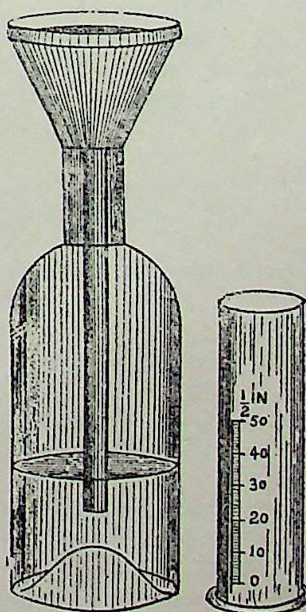


Fig 43 —Rain Gauge.

The rain gauge should be fixed in the ground to such a depth, that the edge of the rim remains at least 12"

above the surface of the ground. It should be fixed in the open space.

To measure hail or snow, it is necessary to melt it by applying heat or by adding a known quantity of hot water and then measured in the ordinary way.

An inch of rainfall represents 22,617 gallons or 101 tons of water per acre or 4.67 gallons per square yard. Roughly one foot of snow may be taken to represent 1" of rainfall.

CHAPTER IX

MEDICAL INSPECTION OF SCHOOLS

As the school children are the future citizens on whom the progress and welfare of a country depends, it is of paramount importance that they should be educated under sanitary and wholesome conditions. Moreover, the impressions formed by the children in their childhood are deep and lasting.

'Unfortunately in this country, subject of school hygiene had rather been neglected.' 'Although of late years, schools of a more sanitary type' have sprung into existence as compared to those in vogue previously,' but the conditions at present are still far from satisfactory.' Keeping in view the ever increasing number of scholars, it is evidently clear, that unless active and energetic measures are taken to safeguard their health in every possible way, the future generations are likely to suffer physically and consequently mentally. It is high time, therefore, that something is done to tackle the problem of school hygiene effectively.

The objects of the School Health Service are as follows :—

(*i*) to build schools on modern sanitary lines.

(*ii*) to appoint suitable medical inspectors or school medical officers.

(*iii*) to make provision of an adequate system of medical inspection of all children at least thrice during the school life or oftener to ascertain the health conditions of students and to detect the presence of contagious diseases and physical defects among them and suggest their remedies.

(*iv*) to establish school clinics.

(*v*) to segregate cases of infectious diseases and establish centres for the prevention of the spread of these diseases.

(*vi*) to teach the practice of hygiene and healthful living to students both in the school and at home.

Site :—The school should be centrally situated, easily accessible to students and should be situated at a distance of at least 60 feet from the main street, so as to eliminate the nuisance of noise which distracts the attention of pupils and teachers and prevents them from concentrating on their studies. The site should be elevated and well drained and should not be overshadowed by tall buildings or trees. If possible a field or a public park should adjoin it. The area of the school should be one acre for 1000 students. A play-ground should be provided at the rate of 20 square ft. per child, which could also be conveniently utilised if need be for open-air teaching.

Building :—The school building should not exceed two storeys in height as a multistoreyed building is difficult to evacuate in cases of outbreak of fire or in the event of occurrence of an accident. As regards the type of the building it should be of the pavilion type constructed like the word "E" in which the class rooms open into the verandah and the hall is quite separate. This sort of arrangement provides adequate ventilation, *i.e.*, air and light to all the rooms of the building. Corridors should be 6 to 8 feet wide and the width of the staircase should be about 4 feet with a doorway opening outside, provided at the bottom of the staircase, as it facilitates the escape of children in case of an outbreak of fire. Each and every part of the school building should be constructed fire proof as far as possible. Moreover, it should be provided with a necessary pacca drain surrounding the plinth.

As regards cubic space, a minimum of the 150 cubic feet per pupil has been laid down in England. The floor space should be from 10 to 15 square feet, so that from 1500 to 1800 cubicfeet of freshair per head is aimed at. The height of classrooms should not be less than 12 feet. Class-rooms should be on the sides, away from roads and should preferably face South or SouthEast for sunlight. Each of the rooms should be able to accommodate 25-50 children. Rooms should preferably be rectangular, the width being two thirds of the length.

A clear space of not less than 7½ feet extending the full width of the room should be left for the teacher. There should be left about one foot of open space between the last row of desks and the wall and a gangway of not less than 1½ feet on one side of the child. Staircase should be separate for children of each sex. Its construction should be fireproof and its width may vary from 4 to 6 feet.

Floors should be made of impermeable material with smooth surface to facilitate easy cleansing. The interior walls should be painted or distempered to permit regular washing.

Ventilation :—Proper ventilation diminishes the chances of infection, lessens fatigue and eyestrain. Provision of artificial ventilation should be avoided. Windows should be placed on the opposite sides of the room and all of these should be made to open, if possible, to the external air. Moreover, these should be sufficiently wide and the ventilators, as far as possible, should reach as high as the ceiling of the room.

Lighting :—Natural lighting should be provided to the school building by the provision of a large number of windows and ventilators. Proportion of the glassarea provided in the walls should be onesixth of the floor area. The main light should come from the left because when one writes with the right hand

his shadow should not fall on the book. Too brilliant light should be avoided by providing sunblinds.

Air of Class Rooms :—A wet and dry bulb thermometer should be fixed in every class room and permissible range of dry bulb should be 60° to 65° F and wet bulb 58° to 61°F.

Warming of Class Rooms :—Hot water pipes are the best for the purpose if need be.

Furniture :—The most important item of furniture for the classrooms is seats and desks. Single seats are considered best. In order of preference, come the dual seats. In the former case each child can be accommodated with the size that is more suitable for him. Moreover, the spread of infectious diseases and verminous conditions can be checked by providing single seats to students. The Sheffield type of continuous desk with six separate seats is preferable to a long common seat and a desk.

Requirements of a Good Seat :—The seat should hold two thirds of the thigh. The front edge of the seat should be rounded and its height from the floor should be such, that when the child's feet are resting on the ground, the legs are in the vertical position and the thighs in the horizontal position. In other words, the height of the seat should be such that the feet should not remain suspended in the air and the scholar should be able to rest his elbows without raising or depressing the shoulders. There should be a provision for backrests suitably curved to the body reaching the level of the shoulder blade. Desks should be from 15″ to 18″ broad, and slope at an angle of 15° and 45° for writing and reading respectively. It should be vertically distant from the seat. The edge of the writing surface should almost fall in a straight vertical line with the edge of the seat. The slight overlap is rather better than the gap. Desks are classified into three varieties depending upon the relationship to the seats :—

1. *Zero desk* :—When the edge of the desk is vertically in line with the edge of the seat.
2. *Minus desk* :—When it overhangs it.
3. *Plus desk* :—When there is a gap between the two.

Zero and minus desks are suitable for reading and writing.

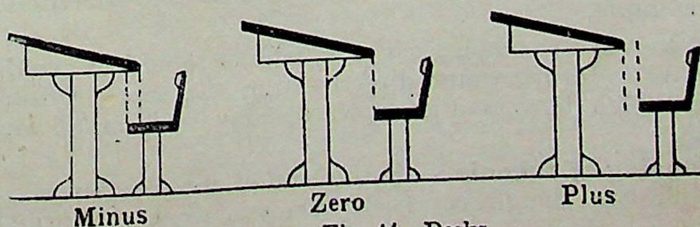


Fig. 44—Desks

Seats and desks should be adjusted to the requirements of scholars twice a year for the prevention of eyestrain and fatigue.

As girls grow most between the ages of 12 to 14 and boys between 14 to 16 so special care should be taken during these ages.

Mattings :—These should not be spread on the floor, when desks and seats are used, as they are not hygienic.

Black Boards and Maps :—Black boards should have dull surface. Maps also should not be glazed.

Posture :—Care should be taken that the students do not acquire physical defects during their schoollife. Too much stooping leads to myopia, contracts the chest, interferes with respiration, curves the spine and puts strain on the heart.

Provision of meals :—Meals are generally not provided in schools in this country. It is recommended that at least one meal should be provided, especially in primary schools, free in poor cases and on payment to the others. This meal should contain protective foods in sufficient quantity. Milk and fruits are especially recommended for this purpose.

There should be licenced vendors who keep the articles clean and covered from flies and dust.

Sanitary Conveniences :—Provision should be made for privies and urinals which should preferably be placed in the playground. Urinals should be constructed of glazed porcelain and should be provided with automatic flushing arrangement. There should be a provision of at least 5 closets and an equal number of urinals for every 100 students. None of the closets should be installed with more than one seat. Waterclosets are, of course, the best arrangement, but in cases where water carriage system is not in vogue, conservancy arrangements should be made. In the case of privies a sweeper should be engaged to clean the privy after each visit. The disposal of nightsoil must be regularly attended to. If funds allow, latrines, with septic tank arrangement, may be set up under suitable sanitary conditions.

Watersupply :—Drinking water should be properly protected from getting contaminated. In places where there is no public watersupply, the well or the tank should be periodically inspected and a sample of water taken for chemical and bacteriological examination.

The use of a common glass or a tumbler should be avoided. It is better to drink water directly from the tap. Drinking fountain, which delivers a jet upward, may be installed where possible.

Cleansing of Schools :—At the end of the day's work, all the schoolrooms should be swept. Once a week the furniture

should be taken out of the rooms and the floors scrupulously scrubbed and swept. Every effort should be made to prevent a dusty atmosphere in schools.

School Health Service :—Medical men, with special experience of infectious and skin diseases, should be appointed. They should have knowledge of examining the eyes, ears, throat and nose. Appointment of one medical inspector for 5,000 children is the standard aimed at. Besides, dentists, and ophthalmologists are also required. Not less than 3 inspections should be made during the schoollife of a child *i.e.*, :—

(*a*) Shortly after the admission.
(*b*) Between the ages of 8 and 9.
(*c*) Shortly before leaving the school.

Defective children require more than 3 (*i.e.* frequent) inspections. The medical inspector should be delegated with the power to exclude any student from school for the following reasons :—(*a*) To prevent the spread of infectious diseases;
(*b*) If the children are unclean and verminous;
(*c*) If the children have any mental or physical defect.

Duties of the School Medical Officer or Medical Inspector :—

1. He should render advice requiring the selection of sites and making of plans for the building of new schools.

2. He should periodically inspect all school premises with special reference to lighting, ventilation and other sanitary installations, and see that these buildings are repaired annually and whitewashed once in six months.

3. He should inquire into the cases of outbreaks of infectious diseases in schools and take all necessary steps to arrest their spread.

4. He should advise periodic disinfection of all school buildings.

5. He should examine all students attending the school and keep a record of their health and also submit monthly as well as annual health reports.

6. He should draw up a system of physical exercise for the school.

7. He should note the effects of desks on the posture of the students.

8. He should examine every child who is reported to be suffering from any disease, defect or injury and give necessary directions.

9. He should give instructions to teachers regarding common ailments and defects of scholars by lectures and demonstrations and give first aid and hygiene training to the school children.

School Clinics :—There are very few such clinics established so far, although efforts are being made to establish them in large numbers. The 2nd Five Year Plan proposed that such clinics should be opened in each district to cover all the schools. The equipment for such clinics includes, a weighingmachine, height standards, a tapemeasure, Snellon's eyetesting cards, tongue depressor and Holmgren's wool. They serve the following purposes :—

1. *Methodical Medical Examination of School Children* :—The medical inspector should follow a routine method and after conducting general and special examination record it on an index card. The following points should be noted :—

1. Name, age, sex, address.
2. Name of school, date of inspection and class.
3. Measurement of height, weight, nutrition, cleanliness, clothing, foot gear.
4. *Personal history* :—Previous illness from an infectious disease, vaccination, immunisation against typhoid, diphtheria.
5. *Special examinations* :—Teeth, nose, throat (tonsils, adenoids etc.) eyes, vision, ears, hearing, speech, mental and nervous conditions.
6. *Diseases or deformities* :—Heart, lungs, spleen, liver, skin, anaemia, tuberculosis, rickets, any special disease and deformities.
7. General observations.

2. *Treatment Centre* :—All minor ailments are attended to in the clinic. Arrangement is also made for the following :—

(*a*) Operative treatment of enlarged tonsils and adenoids.
(*b*) Dental treatment.
(*c*) Treatment of visual defects and provision of spectacles.
(*d*) Xray treatment of ringworm, orientalsore, etc.

3. *Control Centre* :—It serves as a centre for the control of communicable diseases.

4. *Health Education* :—A regular course of hygiene is imparted to the teachers and through them to the students.

Investigation to be carried out, at the outbreak of an infectious disease :—

1. All children from the street or neighbourhood and all scholars from the same class should be carefully examined.

2. All children suffering, from infectiousdiseases should be excluded till they have ceased to be infectious and till the disinfection has been carried out.

3. The contacts should be allowed to return to school after a period slightly longer than the maximum incubation period of the disease. (Table on opposite page).

School closure may be necessary on account of the following reasons :—

1. Disinfection and cleansing after an outbreak of infectious disease.

The following table gives the regulations regarding the period of exclusion of infected children or contacts from other children living in the same house :—

Disease.	Incubation Period (days)	Period of exclusion of infected students.	Exclusion of contacts or children living in the same house.
1. Cholera	1 to 3	Until discharged from the hospital or certified as cured.	Until 7 days from the date certified by the medical officer of health that the house is free from infection.
2. Diphtheria	2 to 10	2 to 3 weeks after discharge from the hospital. If treated at home, the same period supported by bacteriological examination or pronounced free by medical practitioner.	2 weeks after the removal of patient to the hospital. Bacteriological examination should show negative swab.
3. Measles	7 to 14	4 weeks or one week from the date of appearance of rash.	Exclusion for four weeks from the date of the last exposure to infection.
4. Mumps	12 to 25	Until one week from the subsidence of swelling.	No exclusion.
5. Chicken-pox.	10 to 21	Until scales fall off.	3 weeks from the date of last exposure to infection.
6. Small-pox	Usually 12	Six weeks until the child is free from infection.	16 days unless recently vaccinated, when exclusion is unnecessary.
7. Whooping cough	6 to 18	Six weeks from the commencement of cough.	3 weeks from the date of last exposure to infection.
8. Influenza	2 to 3	About a fortnight.	10 days.
9. Scabies		Until recovery.	No exclusion.

2. Rectification of sanitary defects, not as a matter of mere routine.

3. Sickness in teacher's family involving risk to students.

Special Schools :—These may be opened for mentally defectives, for the blind, the deaf and the dumb. In some areas, special residential schools are available for epileptic and cripple children.

Openair Schools :—These are established in certain countries for weak children suffering from adenoids, tonsils, rickets, malnutrition or anaemia, for convalescents from pneumonia, measles and other diseases, and for the children of consumptive parents.

Child Guidance Clinics :—These have been established in many of the larger towns, for dealing with children suffering from lesser degree of mental defects, which often come to the notice on account of behaviourdifficulties rather than mental dullness, such as aggressiveness, cruelty, delinquency or nervous manifestations of some kind. The typical childguidance clinic is run on a team basis with (a) the Child Psychatrist (b) the Educational Psychologist (c) Psychiatric Socialworker (d) Psychotherapist. In many cases a little simple advise to the parents suffices; in others simple therapeutic measures with some play therapy may be necessary. In the more severe cases, however the child may be required to leave his home and is then sent to a boarding school or hostel and attends a different school, while obtaining treatment at the school or hostel.

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CHAPTER X

MATERNITY AND CHILD WELFARE

It is a service maintained for the supervision of health of mothers and children. It is only in the recent years that the importance of this branch of public health has been fully realised in Western countries. In India, maternity and child welfare and its associated activities are still in infancy.

To have a proper idea of our present backwardness, one should look at the infant mortality and maternal mortality rates in India and compare them with the corresponding figures of England and U.S.A.

Infant mortality rate :—It is number of deaths in a year, under one year of age per 1,000 births.

Maternal mortality rate :—It is the number of deaths of women due to, or associated with, pregnancy and child birth per 1,000 births. In theory the rate should be expressed per 1,000 pregnancies, but complete notification of pregnancy could never be achieved, so we must be contented with current rates.

	India	*England*	*U.S.A.*
Infant mortality rate	127 (1950)	30 (1950)	29 (1950)
Maternal mortality rate	20 (1945)	0·65 (1951)	0.9 (1949)

Abortion :—It indicates expulsion of foetus from any cause before it is viable, *i.e*, before the 28th week of pregnancy.

Still Birth :—It signifies the birth of dead foetus at a period at which it is viable.

Causes of Infant Mortality :—

(*a*) Possible causes :—Poverty, defective sanitation, bad housing, atmosphericpollution, overcrowding, improper feeding, untrained midwives, ignorance of mothers, etc.

(*b*) Chief pathological causes are :—Prematurebirth, diarrhoea, debility, marasmus, smallpox, measles, whooping cough, bronchitis and pneumonia.

Out of infant deaths 47% occur during the first month of life, chiefly in the first week. They are less amenable to control than subsequent deaths.

Maternal Death Rate :—There are two groups of maternal deaths :—

1. Deaths due to puerperal sepsis.
2. Deaths due to diseases and accidents of pregnancy and childbirth, *i.e.*, antepartum haemorrhage, accidental haemorrhage, syphilis etc.

Puerperal Sepsis :—This is the most important single cause of maternalmortality. Then comes anaemia, eclampsia and other toxaemias, shock, ante and post partum haemorrhage and embolism. Abortion is responsible for certain proportion of maternal deaths owing to sepsis or other causes.

Prevention of High Infant and Maternal Mortality Rates :—The following measures should be adopted :—

1. Appointment of lady healthvisitors. They are trained midwives, who have obtained Lady Health Visitors' diploma by undergoing training in a Health School for a period of one and a half years.
2. Provision of maternity and child welfare centres and clinics for mothers, *i.e.*, education of mothers in mothercraft in general, and expectant mothers in particular.
3. Opening of infant milkdepots where milk is given free or at nominal price to the poor.
4. Providing meals for poor expectant and nursing mothers.
5. Opening of *creches* or daynurseries for factory or working women. Here working mothers can leave their babies to be lookedafter whilst they are away for their work.
6. Maternity hospitals and nursinghomes should be provided.
7. Opening of schools for training of indigenous dais, midwives and ladyhealthvisitors. No untrained dai should be allowed to practice.
8. Publishing of leaflets giving instructions regarding the maternity and childwelfare work and delivering lectures and conducting classes in connection with child welfare work.

Duties of a Lady Health Visitor :—She should be a trained woman holding a diploma. Her duties are as follows :—

1. Ante or Prenatal work :—She visits mothers in their homes, giving instructions to expectantmothers, advising them how to remain healthy during pregnancy and make preliminary and necessary preparations for the coming event.
2. Systematically visiting and supervising all children born in their area and also attending to their mothers. This is called postnatal work.
3. She attends the maternity and child welfare centre. One lady health visitor is enough for 200 to 240 births per annum. She has under her care about 600 to 700 preschool children.
4. She improves the home conditions of mothers by rendering help and advice.

5. She weighs the children who attend the welfare centre periodically. A steady increase in the weight of children being a sure indication of good health and progress.
6. She instructs mothers regarding infant feeding and mothercraft, (generally about the dress, bath etc.).
7. She treats minor ailments of infants and their mothers.
8. She helps the midwives and dais in case of difficult labour.

Welfare Centre :—These are established under the supervision of Medical Officers of Health. The essential provision for such a centre is a well-qualified lady health visitor, who is assisted by a trained dai.

The centre should consist of :—

1. A waiting room.
2. A consultation room.
3. A small dispensary.
4. A weighing room.
5. A lavatory adjoining the waiting room.
6. Staff quarters for the lady healthvisitor and trained dai in close proximity to the welfare centre.

The staff should consist of :—*1. A lady healthvisitor* :— One lady health visitor can annually attend to about 200—240 births, 200 infants and about 600—700 per-school children.

2. A ladysuperintendent :—She is a voluntary honorary lady worker, who can afford to spare some time to assist the lady health visitor in her work.

3. A visiting lady medicalofficer :—She attends the centre once or twice a week. She is a specialist in diseases of women and children and runs antenatal and baby clinics.

4. Dais :—One or two traineddais, or mid-wives are attached to the centre to render assistance at the time of delivery to poor and deserving mothers.

5. Specialists :—In some of the centres venereal, orthopaedic or dental specialists also attend the centre once or twice a fortnight.

The lady healthvisitor obtains reports of births from the office of the registrar of births regarding her area and then, assisted by a few voluntary lady workers or trained dais attached to the centre, visits their homes and gives practical advice and stimulation to ensure that the child is tided over the dangerous period of its first 12 months of life. Mothers should be well advised to attend the centre periodically which should be easy of access and if possible there should be opened a welfare centre

in the lady health visitor's area. The chief value of the centre is to provide medical and hygienic advice to the mothers who should be urged and persuaded to bring their children to the centre for periodical checkup whether they are ill or not. If possible the same medical man and in this country the same medical woman should attend at suitable intervals, say twice a week. There should be arrangement in the centre for weighing and measuring babies and for carrying out testfeeds etc.

The waiting-hall should be used for mother's meetings, holding demonstrations and delivering lectures to mothers. The walls should be decorated with instructivediagrams and charts.

Leaflets in different languages should be giving instructions regarding maternity and child welfare work. Annual baby shows may be held in the centre. In some centres provision for cheap meals for poor expectant and nursing mothers need to be made.

Milk should be supplied free or at nominal cost to needy mothers and children.

Provision of trained midwives and dais for the poor and needy mothers at the time of confinement should also be made.

In some centres dental or venereal clinics and clinics for orthopaedic work, and ultraviolet treatment are also provided.

Scope of Maternity and Child Welfare Work :—It is :—

(*a*) Prenatal or Antenatal (before delivery)
(*b*) Natal (at delivery)
(*c*) Post natal (after delivery)

(*a*) **Prenatal or Antenatal Work** :—Provision should be made for the pregnant or expectant mothers to be under expert medical advice and for this purpose prenatal examination be held weekly at maternity or health centres or at a recognised place. If necessary, pelvic measurements be taken to take note of the prevalence of rickets and pelvic malformation. Urine should be tested in all cases and careful record kept to know of eclampsia. The bloodpressure is also noted. In these clinics many of the maternal diseases which bring about death in newly born children can be diagnosed and treated. Treatment of minor ailments of women and children is done in the centre. Articles, like varicosebandages, pessaries, and drugs like castor oil should be sold to the mothers at cost price.

They should be examined every month for first six months and every fortnight from sixth month onward. A minimum of three medical examinations are necessary. The first complete examination should be done between 6th and sixteenth week of pregnancy to ensure that woman is fit for the strain and detect such abnormalities as syphilis, tuberculosis, early toxaemia and

anaemia. Her daily routine is to be chalked out. The second examination is done about 32nd to 36th week to diagnose the presentation, position and to carry out obstetric manipulation, which may be necessary. The third examination on 38th or 39th week is directed for the detection of any disproportion between the head and the pelvis. Urine and blood pressure examination is also carried out, each time the mother visits the clinic.

Lady healthvisitors should periodically visit the homes of expectant mothers, particularly if they are not regularly attending the centre.

Provision of maternity hospitals should be made in which all complicated cases of pregnancy should be dealt with by the expert medical staff.

The other activities are groupteaching of the expectant mothers regarding mode of living, care of bowels, nourishment, work, exercise, bath, etc. Arrangement should be made for the supply of extra nourishment and maternity outfit to poor deserving mothers.

Clinic meant for antenatalcare should perform the following functions :—1. To render advice to expectant mothers regarding the special hygiene of their condition and prepare them for confinement.

2. To diagnose serious troubles like cardiac and pulmonary diseases, etc.

3. To render advice on minor disabilities of pregnancy, dyspepsia, constipation etc.

4. To examine urine and palpate abdomen. Internal examination should be conducted only where indicated by history or any particular symptom.

(*b*) **Natal Work** :—*1. Domiciliary Midwifery* :—A skilled and prompt assistance should be available to the expectant mother during confinement at home which can only be done by providing trained midwives or dais who should always be available in the centre. They should be provided residential quarters near the maternity centre so that their services be available at all hours. This service is less expensive, and simple to arrange. It is safe for normal confinement even in the housing conditions which are not ideal, but it is unsafe for even minor obstetric interference. For domiciliary work in urban areas, a provision of one midwife for 100 births is aimed at, but in rural areas, due to great distances and poor means of communication the provision should be more generous.

Medical and consultantaid, transport arrangements and sterilized maternity outfits are essential to complete domiciliary midwifery service.

2. *Institutional Service* :—It is needed for abnormal labour, for normallabour of primipara and for mothers whose home conditions are not suitable for domiciliary midwifery. Sick women with contracted pelvis or those suffering from any other abnormality involving danger to life of the mother or infant are confined at a maternity hospital.

3. *Nursing homes* should be provided for the confinement of midwifery cases.

(*c*) **Postnatal Work** :—1. The registrar of births notifies the birth to the lady healthvisitor in her area. She should resort to home visiting and undertake the treatment of complications found, whether in mother or in the child. She should train the mother regarding infant feeding and the method of weaning the child. She should also deal with the problems of clothing, bathing, teething, habittraining and minor ailments.

2. The lady health visitor should visit every infant once a month and each child between 1 and 5 years of age at least once in every three months.

3. Baby or infant clinics should be opened, where systematic advice should be given to the children regarding their welfare upto the age they are not admitted to a school.

4. Dental and venereal clinics should be opened at suitable places.

5. Arrangement should be made for the sale of clothings to the poor women at cost price.

6. Provision of milk and food depots for mothers where milk should be supplied to expectantmothers, infants and nursingmothers at nominal charges in deserving cases.

7. Creches or daynurseries should be provided for working mothers, where they can leave their babies to be looked after by nurses before going to their work.

8. Treatment in hospital under the expert medical advice, of the complications after labour either to mother as puerperal sepsis or to infant as ophthalmia neonatorum, prematurity, etc.

Provision of Lady Health Visitors, Midwives, Nursedais and Traineddais :—In the Punjab state, the Punjab Nurses Registration Council maintains a register, where all qualified lady health visitors, midwives, nursedais and traineddais are registered. It is essential that qualified midwives and dais be attached to the maternity and child welfare centres where people who require their services should apply. In a complicated case *e.g.* where puerperal sepsis takes place the midwife or the dai at once calls for a qualified medical man or woman to do the needfnl and to render expert medical advice. The Punjab Nurses Registration Council supervises their work in the state.

Training :—(*a*) *Lady health visitor* :—The preliminary qualification required from a candidate for admission to the Lady Health Visitor's Course, is that she should have passed matriculation examination with full subjects and undergone training in midwifery for 1½ years in a recognised hospital. After this she joins a Health School where she obtains a diploma of Health Visitor course after undergoing further training for 1½ years.

(*b*) *Midwife* :—She should have passed anglo-vernacular middle examination but preferably be a matricualute. She undergoes 1½ years training in a recognised hospital.

(*c*) *Nursedai* :—Preliminary qualification for admission in this course is that girl should have passed anglovernacular middle examination. By joining the course she undergoes 2 years training in a recognised hospital. She has to appear and pass the midwives examination also.

(*d*) *Traineddais or Indigenousdais* :—Preliminary qualifications for admission in this course are that the applicant should be a literate woman, intelligent and should have special aptitude for this kind of work. She is trained by the lady health visitor in maternity and child welfare centres and receives training for about one year where she has to personally conduct herself at least 6 maternity cases and also attend certain number of lectures and demonstrations.

In all these cases, the examinations are arranged by the Nurses Registration Council.

To sum up :—Health visitors should pay their first visit to the newly born infant 10 days after birth when in normal cases the services of the midwife are no longer required. The mother should be persuaded to bring her child to the consultation centre regularly once a fortnight, or once a month as considered necessary. Periodic visits should be paid by the health visitors subsequently to the homes of infants until they are about one year old. Frequent visits are necessary, if the infant is not progressing satisfactorily, where mother is inclined to be negligent and the infant is not brought regularly at the centre for medical check up.

After first year of life, the house where the family resides be visited from time to time to ascertain if the child is progressing satisfactorily and the mother should be persuaded to bring the child periodically to the centre if his health is found unsatisfactory. Paying of subsequent visits may cease at the age of 5 years or earlier if the child has been admitted in the school. Register and the relevant records accumulated by this time regarding the condition of health of the child at various

ages should be passed on or made available to the school medical inspector.

By adopting the above system of periodical checkups many of the disabling cases of early childhood may be prevented and the child enabled to begin the school life, with the best prospects of deriving maximum benefit from education.

CHAPTER XI

PERSONAL HYGIENE

Personal hygiene may be defined as that branch of hygiene which concerns itself with the adjustments which the individual must make to preserve and improve the health of his body and mind.

Health may be defined as the quality of life that enables the individual to live most and to serve best. It can be imperilled either by doing or by neglecting to do certain things. Health is capable of enrichment or deterioration ; that life at its best is a more realistic concept for all persons than the mere avoidance of disease and that the proper goal of all health teaching is the finest kind of individual living. Personal hygiene is not only concerned with matters pertaining to health of a person but also includes certain personal factors conducive to good health. They are habits, constitution, heredity, idiosyncracy, temperament, cleanliness, sleep, clothing, exercise, sex, etc. The main object of personal hygiene is to maintain a high standard of health.

Habit :—This plays an important part in the preservation of health. Habits can not be learnt out of books ; they must be developed and practised in daily living. They are more difficult to change, than they are to form. Habit is called second nature, because it is readily formed, grows by practice and eventually becomes part and parcel of nature and part of individual's life and character, thus making its eradication, a matter of great difficulty. A person may deliberately repeat actions, until they may become a habit or they may subtly grow from unconscious responses to stimuli, so that he may not know when they began as is often done through unconscious imitation. The development of good habits will influence the child in right action and right thinking. Proper health habits constitute the only sound foundation upon which to build permanent physical and mental health, for it is what we do habitually that determines the level of health we attain. Habits are largely responsible for determining one's quality of life.

Habits should be regular and healthy, with regard to the hours of meals, the evacuation of bowels, the professional work and the use of restorative drugs. This subject may be dealt with under various heads :—

1. *Eating and Drinking* :—It is essential to form a regular habit regarding eating and drinking. Only wholesome food should be taken. Meals should be taken after due intervals, at fixed hours and quantities compatible with one's work. It is a bad habit to overload the stomach. One must always wait for

a true appetite. The food should be taken for which the appetite particularly craves for. It should be properly masticated and eaten slowly. Every morsel should be bitten 32 times. Bolting of unchewed morsels should not be done. Reading should be avoided while taking meals. It is desirable that there be agreeable society at the time of taking meals. Intellectual work, especially hard study, should not be done after a heavy meal. Children may be easily hurt due to lack of food, but moderation in eating is of great importance for the old persons as processes in their bodies are much slower at that age.

Water should not be taken along with meals, but should be taken freely between principal meals. It is a good habit to take a glass of cold water early in the morning on rising from the bed. Infants, like adults, require water and suffer from thirst and so should be given sips of water to drink.

Alcohol :—It is a food and a narcotic, but its food value is very limited. It can replace an equivalent amount of carbohydrate or fat and economise proteins. But it can definitely neither be stored in the body, nor utilized for repair. Although on certain occasions, if used in small doses, it may aid digestion or induce sleep but it has a devitalizing action upon the tissues, the symptoms of which range from some impairment of function to gross degenerative lesions. The feeling of exhilaration that follows a mild dose of alcohol is due to paralysis of higher nerves centres that normally provide inhibition. With these centres shut out from the rest of nervous system the individual feels the restraint of dignity and propriety and tends to give free reins to his impulses. The condition known as "Delirium Tremen's" which is an alcoholic Psychosis with symptoms of delirium, trembling, and mental distress is thought to be due to vitaminstarvation and the toxic effect of alcohol.

In its passage through the different tissues, alcohol has different effects :—

(1) On the centralnervous system it acts as a narcotic which may begin with the production of a pleasant state of Euphoria *i.e.*, the fading out of disturbing and unpleasant facts of life, progress to stupor then coma and even death in rare cases. The first higher centres of the brain to be effected are those which control memory, attention, thought, judgement of self-control ; later muscular and sensory functions are interfered with.

(2) Through the nervetissues governing the heart, alcohol increases the rate of contraction causing rapid heart beat.

(3) By dilating the bloodvessels, at the surface of the body, alcohol interferes with the heat regulating mechanism, producing a sense of warmth in the skin and actual loss of internal body heat. The loss can be serious in cold weather if the body is not well wrapped.

(4) By acting on the nervetissue in the special sense organs it can produce error and delay in observing through eye and ear ; a very dangerous effect in persons driving a car—or aeroplane. In view of its slow rate of elimination from body these effects of alcohol may be maintained for some hours after the drink has been taken.

(5) As regards the respiratory processes moderate amounts of alcohol produce little effect but large amounts may cause paralysis of the respiratory centres and lead to death.

(6) In the case of digestive processes peristaltic action may be lessened and flow of saliva increased as also of the gastric juice with the difference that this is lower in pepsin contents but higher in, hydrochloric acid content than normal—a change liable to be harmful to persons suffering from peptic ulcer.

(7) One general effect of excessive intake of alcohol is that normal restraint in conduct may be lost, involving the risk of promiscuity, and of contracting such diseases as gonorrhoea and syphilis.

Chronic alcoholism develops slowly and more particularly in persons using beverages of high alcoholic content such as spirits. Gradually personality and intelligence are affected, followed by physical impairment of the organs of digestion, the liver and the nerves. There is a lowered resistance also to respiratory and septic infections and shortening of normal expectation of life. Often the chronic alcoholic develops into a person who feels himself to be misunderstood, persecuted and inadequate to the demands made upon him.

Avoidance of the dangers of alcoholism involves restricting one's consumption of liquor to beverages of less than 10% strength, taking drinks slowly with, or soon after meals rather than on an empty stomach and taking drinks only when day's work is over and there is no intention of taking—either physical exercise or undertaking tasks *e.g.*, driving which requires caution, skill and accuracy.

Use of alcohol and other liquors should therefore be avoided. It does not remove fatigue but makes one unconscious of it and blunts one's recollections of the difficulties and worries of the day.

The real danger of its use is its habit formation nature and for persons having weak self control, it very quickly ceases to be their servant but becomes their master. Alcohol is responsible for many crimes, accidents and so many bodily and mental injuries and diseases.

The drugs of addiction, usually opium and cocaine, are strongly habit forming. The former is a depressant and the latter is a stimulant. Heroin and Indian hemp are the favourite narcotics of addicts. Their deprivation produces physical and mental torture. Their use should be therefore avoided.

Tea and coffee are both dangerous but less habit forming than alcohol. In addition to being pleasant beverages they are useful as stimulants. Excess of the use of either is injurious as it leads to great mental stimulation and to loss of sleep. In moderation both are however useful in removing the feeling of fatigue and enabling a person for a time to draw on his reserve energy.

Smoking :—It is not essential and should be avoided by young persons. It harms digestion. It causes sorethroat coughing and wheezing. Insistant smoking often results in unsteadiness, trembling of fingers and frequent disturbances at night due to drycough. Moreover the heavy smokers are likely to suffer from bronchitis which may become chronic and cause serious diseases of lungs. Many cases of the so called "smokers cough" may be the beginning of bronchitis. In moderate dose it however tends to stimulate the higher centres of the brain but in larger amounts its action is chiefly sedative. Smoking may affect any tissue in the body. Every heart specialist tells his patient either to stop smoking or to cut down on it. It is believed that cancer of lungs is due to smoking. The heavysmoker's giddiness, breathlessness and tremors are largely due to mild chronic carbon monoxide poisoning. Heavy indulgence is associated with curtailed longevity.

Moreover, alkaloid nicotine of tobacco may cause premature hardening of arteries leading to arteriosclerosis and rise of blood pressure. It may be remembered that nicotine extracted out of 3 cigars is enough to kill a man provided it is injected into his veins. Moreover, pyridine, ammonia, aldehyde and furfurol present in the smoke of tobacco have irritant properties. Pyridine causes darkened teeth, ammonia irritates the throat and carbon monoxide destroys red blood cells.

The *hooka* or hubble-bubble is a better way of smoking tobacco as smoke, in passing through water, loses some of its nicotine and other harmful ingredients.

The tobacco chewing habit is most condemnable as a great portion of the juice is absorbed even if the saliva is not swallowed and thus it must be avoided.

Indigestion :—It occurs when the food fails to be digested properly.

Causes :—They are :—

1. Unbalanced diet.
2. Eating between meals.
3. Rapid eating.
4. Chewing the food too little.
5. Constipation.
6. Unpleasant surroundings while eating.
7. Eating while angered, worried or fatigued.
8. Sometimes in diseased condition, such as gall-stones, ulcers or chronic conditions.

If indigestion occurs from any cause, do not eat any food and if you feel hungry take liquid foods for next 24 hours.

Constipation :—It is an evil. It leads to intoxication. If prolonged, may help to cause piles. It is reasonable to eliminate waste matter from alimentarytract as soon as possible. One good motion a day is useful and practicable ideal to aim at.

A habit of using medicines to relieve constipation is harmful. In habitual users of purgatives, the entire intestinal rhythm is upset. Movement of bowels is, very largely a reflex and training should aim, at a very early age, at establishing the reflex. Call to evacuate the rectum should not be ignored, as the neglect to do so is the chief cause of constipation. Other factors are lack of exercise, insufficient intake of fluids and a diet containing too little roughage and too little fat. Hurried eating habits and too little rest may also contribute to this condition. Poor posture leads to bending of the body forward and crowding of the abdominal organs. This position leads to weaken the muscles of the abdomen and to cause a sagging of the organs which results in constipation. Displacement or diseases of abdominal organs may also be a cause of constipation. Constipation, if not too firmly established can be corrected by modification in diet and habits. Presence of vitaminBcomplex in adequate amount in the diet is now regarded as essential to the activity of the bowels and the best way to secure it, is to eat wholemeal bread, salads, vegetables and fruits.

One should cultivate the habit of evacuating the bowels at the same time each day. If a regular habit is not formed, constipation is bound to occur and this will produce indigestion and piles and will tend to induce appendicitis. Regulation of elimination of waste materials from the body is helped by :

1. Drinking a glass of water early in the morning.
2. Going to the toilet regularly.
3. Taking exercise regularly out of doors.
4. Eating some coarse bulky foods *e.g.*, greenvegetables, bran, wholegraincereals, fruits with their skins.

Control of Weight :—Obesity or overweight is an abnormal and dangerous condition in which there is stored a large surplus of fat within the body. Its accumulation beyond the normal limit may be due to endocrine dysfunction causing an abnormally low metabolic rate, but in a large majority of cases, it is due either to excessive intake of food or to a deficient utilisation of the food than to produce energy.

Fat in food is the most common cause of overweight, which at first may cause merely discomfort and later on may menance life. It increases susceptibility to diabetes, kidney diseases, heart-failure, diseases of arteries, liver and gall bladder diseases, cerebral haemorrhage and a number of other ailments. Excessive weight of 10 percent above the normal increases the mortality toll about 20 percent and the greater the amount of surplus weight, the higher the deathtoll.

Efforts should be made for the prevention of obesity and for correction of overweight. The principle underlying is that weight should not be restricted by interfering with the normal development of bone and muscle. Obesity can be prevented in those taking too rich food, by increased exercise, or in those taking too little exercise, by food restriction. The correct method of control is selection of food and by restriction of its amount. Both fats and carbohydrates if not combusted, accumulate as fat. So a nonfattening diet may provide proteins liberally, but should restrict fats and carbohydrates. Bulk which satisfies hunger, is achieved by the use of foods rich in water, poor in carbohydrates and fats, with considerable proportion of material which cannot be absorbed. Such foods include most fruits and leafy vegetables. Proteinfoods should not be reduced in amount unless the individual used them in excess. Starchy foods should not be entirely eliminated, for the storedfat is oxidised much more readily and safely in the presence of carbohydrates. If the daily food intake is kept about 500 calories below the energy needs of the body, a loss of one pound of weight a week may be affected. Such a dietary forces the body to oxidise its own fat to meet the daily energy needs. Will power and perseverance are required to carry through a reducing programme.

Dangers of Reducing :—It is dangerous to reduce weight rapidly; reduction of weight more than ½ pound per day is unsafe. Rapid reduction of fat leads to the production of fatty acids in excessive amounts. These acids cannot be neutralised as rapidly as they are formed and therefore may lower alkaline reserve of the body, sufficiently to give rise to the condition of acidosis. When fat is oxidised slowly in the body with other foods it does notb ecome toxic.

Food restriction is sometimes resorted to by girls and young women with a desire to become slim. This should be condemned

in those, who are normal or below normal in weight because they are liable to develop tuberculosis. The use of drugs like thyroid extract, dinitrophenol etc., is exceedingly dangerous and their use for this purpose should be prohibited.

Frequently advertised remedies for weightreduction, by acting as metabolic stimulant or strong laxatives must be avoided.

Underweight :—The main causes are insufficient amount of food, an unbalanced diet. too little sleep, chronic infections and worry. If the individual is undernourished, he may look pale, have poor posture, flabby muscles, dark circles under his eye, decreased appetite and he often shows irritability.

Fatigue :—The blood supplies fuel and oxygen to the active muscles and carries off the waste materials formed by the activity of the muscles. If the activity continues for too long or happens to be too strenuous, the blood cannot carry away wastematter sufficiently fast. Therefore wastematerials accumulate in the muscles and make them tired. The feeling of weariness is known as fatigue. Fatigue reduces both the quantity and quality of work one normally can do. Worry infrequently is a fore-runner of fatigue. A person cannot do his best when worried.

Degrees of Fatigue :—Fatigue in one part of the body follows overactivity of one group of muscles such as in arm raising. The aftereffects of such overexercise can result in pain, soreness in arm muscles, etc.

Sometimes larger group of muscles are affected as in swimming, climbing, wrestling. In this case fatigue affects the whole body.

Overfatigue results when we use up physical and nervous energy faster than it is restored. Overactivity at work or play combined with late hours and nervous excitement is a common cause. There is serious interference with proper rest and sleep so that one gets up in the morning tired instead of refreshed. There is a drawn and pinched appearance of face and dark circles appear under eyes. The wise people have learnt the art of avoiding fatigue. There are just two secrets to avoid fatigue, to live and work at a sustained pace, without strain, without overdoing and without knowing the meaning of fatigue. These are :—

(*a*) Taking a balanced vitaminmineralrich diet.
(*b*) Knowing the art of relaxation.

Relief from Fatigue :—The accumulated wastes and poisons of fatigue are carried off by the blood during rest and sleep. The worn-out cells are repaired and normal energy is restored: Vigorous exercise, even to the point of being tired is beneficial if normal energy is restored by rest and sleep. After strenuous exercise a hot shower or tub bath is helpful in removing fatigue.

The heat increases perspiration and helps the body to get rid of the poisons of fatigue. Light massage (rubbing) from extremities towards the body will help in removing the waste products from the tissues of the broken down muscles and relieve fatigue. After hard exercise, a good rub down is a necessary part of training routine.

In the case of extreme fatigue the muscles become sore and painful. Exercise increases the pain. In such cases the muscles should be given rest. Warm and hot baths will give some relief.

Anger :—It has been found that it occurs more often before meals ; that tense persons are susceptible ; that one can not become angry when relaxed ; that laughter helps to avoid anger. If the response to anger can be postponed for a few minutes the emotions which it arouses can be handled in a more mature way. Exercise or even a walk may help. Kill your anger before it kills you. It does kill indeed. An angry man is always full of poison. The results of the rage are :—

1. Increase in blood pressure is very often caused by outbreaks of temper.
2. There is rise in pulse rate and sweat secretion.
3. Bloodpressure drops when there is decrease in rage or decrease in general emotional tension.
4. Asthma has been found to occur, parallel to conscious or unconscious reactions of anger.
5. There is a loss of appetite and sugar appears in urine.

Sleep :—Sleep signifies rest of the brain, but the spinalcord and the autonomic system never sleep in the true sense. Nature demands rest after activity. During the hour of activity our tissues undergo wear and tear and to repair the exhausted and wornout tissues it is essential to take rest and fall asleep. During sleep, waste products are eliminated from the tissues, metabolism is set at a low level, the rate of heart beating slows down and the brain is no longer a subject to continued stimulation from without. In fact, it is time for the repair and refreshment of the wholebody and mind.

Amount of Sleep Required :—It varies with the age. During the period of growth and development of all parts of the body, from infancy to youth, from youth to middle life and old age there should be provision for sufficient rest and sleep. As a general rule, the younger the person, the greater the amount of sleep he requires. The infant under one year of age should sleep for 20 hours out of 24 hours, the child aged 1-2 years for about 15 hours, and so on with a gradual reduction to 12 hours at 8 years and 11 hours at 12 years. The infant should be regularly fed and excepting these feeding hours he should be allowed to sleep comfortably. Lack of sound sleep indicates illhealth of

infants as well as of adults. A boy or a girl up to an age of 15 years ought to enjoy at least 8 hours sleep. For an active industrious youth nothing less than 6 hours continuous sound sleep is enough.

Midday Sleep :—In hot climates there is a tendency to indolence and lethargy. During midday, a short nap, especially in the summer, if taken by those who are particularly engaged in doing active work in the morning proves not only to be refreshing but also invigorating.

For those who are engaged in mental work, sound sleep is as necessary as those engaged in physical work. Those above 60 need more sleep than they needed in the middle life or they should spend at least 8 hours lying on the bed comfortably with all portions of the body resting on or about the same level, so as to save their hearts from the strain of pumping blood against the force of gravity.

Weak, debilitated, sick persons and convalescents require more sleep and they need lying down on the bed for a longer period than healthy ones. The best time to sleep is the night time because it is quiet at that moment and all the external stimuli are absent.

The bed room should be wellventilated and should be preferably situated on the upper storey. Its doors and windows should be kept open but draughts should be prevented. The bed should be firm and elastic with a neat and clean bedding. It is injurious to sleep on the floor as there is a danger of being bitten by scorpions, snakes and other poisonous insects and also there is a danger of contracting rheumatism. To woo sleep certain things are helpful—exercise carried not further than tiredness, and certainly not to the point of exhaustion, a due allowance of fresh air during the day, avoidance of a heavy meal within several hours at the time of going to bed. of heavy smoking and of mental excitement, a regular hour for retiring, a comfortable bed, warm feet, good ventilation and absence of external stimuli. Two persons should not sleep in the same bed as they will inhale each others' breath. The use of double bed should be discouraged. The old proverb "Early to bed and early to rise" should not be forgotten. A mosquitonet should always be used at night. Some people, however, feel stuffy inside a net and avoid using it. Drugs should never be used to induce sleep except in illness and that also with discretion.

Sleeplessness or Insomnia :—It is a very frequent condition and one incompatible with physical and mental health. There are many factors that may cause sleeplessness. Emotional excitement at bed time, improper food, insufficient amount of exercise, studying late at night, inability to ban from mind the

events of the day, constipation or worrying over real or prospective troubles may keep one awake. Drinking coffee at the evening meal affects some people by delaying the onset of sleep. Insomnia is more prevalent among brain workers than amongst those who do physical work.

Insomnia in many cases can be overcome by one or more of the following methods :—

1. Having regular bed time.
2. Assuming a calm, mental and emotional attitude on retiring.
3. Taking physical exercise at bedtime, such as brisk walk in the open air.
4. Drinking a glass of hot milk just before going to bed.
5. Thoroughly relaxing the muscles of the body.
6. Reading a short story before going to bed to divert the train of thought away from the daily cares.
7. Taking a fifteen minutes tub bath with the water at about 95°F.

An individual troubled with insomnia should not permit himself to worry about it. Worying about it may do more harm than the loss of sleep. Freedom from anxiety removes a large measure the harmful results of loss of sleep and produces an attitude of indifference which tends to induce sleep.

Constitution :—Individual variations in constitution exist in different persons. Some are strong and robust, while others are feeble and weak. Moreover, power of resistance to disease also varies from man to man and is dependant upon the constitution of the individual. A man, with strong and robust constitution, does not fall so easy a prey to an attack of a disease as does a person having a poor constitution. The constitution of a person is partly acquired and partly inherited. A strong constitution may get enfeebled under unhygienic conditions, while a delicate constitution may improve under hygienic conditions.

Heredity :—This bears a great influence upon the health of an individual. When the body cells divide and multiply, the pattern of their genes is passed on, carrying with it. its ancestral characteristics. Thus the proportion of people who have blue or brown eyes is determined in this way. Similarly certain diseases like gout, insanity, syphilis, haemophilia, colour blindness epilepsy, myopia etc., are transmitted to the off springs in this way. Mental peculiarities and similarity of features are often inherited.

Environment :—In general the environment embodies three aspects. namely the physical, the social and the biological. The physical environment constitutes the varying

range of uatural factors like climate, soils, plains, forests, mountains, lakes, rivers, rainfall etc. It also consists in adoptation and construction of man as represented in items like apartment houses, cultivated fields, use of electricity, radios, motionpictures, newspapers and other countless implements devices of an industrial age. On the other hand, the social aspect of the environment is represented by the people and their actions. The latter are indicative of traditions, customs, superstitions, which man has created. Similarly biological environment comprises plants and animals including those bacteria and parasites which cause disease.

Idiosyncrasy :—By this term is meant a peculiar susceptibility of some persons to be influenced by certain morbid agencies or medicinal preparations *e.g.*, the appearance of nettlerash on the bodies of some members of a particular family as a result of taking shellfish. Food idiosyncrasy is hereditary.

Cleanliness .—This is very essential for the upkeep of our health and for the normal growth of our body. There is a proverb, "Cleanliness is next to Godliness". Dirt is not only harmful but it is antagonistic even to our very existence. Therefore special emphasis should be laid on cleanliness with regards to the food we eat, the air we breathe and the water we drink.

Skin cleanliness is desirable from the aesthetic as well as hygienic standpoint. It makes for bodily comfort and self-respect. In India skin is of immense value, as a lot of perspiration and excretion of solids take place through its innumerable minute pores. As a matter of fact, a great deal of the work of lungs and kidneys is performed by the skin. Hence it is most necessary to keep the skin free from dirt, so that the sweat glands may function properly. Certain parts of the body, like armpits, give out an unpleasant odour from their secretions and so require scrupulous cleansing regularly. Cleansing of skin and the removal of its sebaceous secretions of the skin is best affected by soap and water.

In India anointing of the body with certain vegetable oils is a very popular custom. It keeps the body cool, renders the skin soft and supple and supplies fat to the body. By kneading and rubbing the body, the circulation of the blood is quickened and the muscles are exercised. It makes the man cheerful and refreshed.

Baths :—These are not only very necessary for cleanliness but also for their beneficient action on the skin and internal organs. A bath should be taken early in the morning or in the middle of the day, before taking meals. It should not be taken immediately after meals or after exhaustion due to fatigue.

Baths may be classified as under :—

Cold Bath	33° to 65°F.
Tepid Bath	80° to 90°F.
Warm Bath	90° to 98°F.
Hot Bath	98° to 100°F.

Cold Bath :—Young healthy persons should use cold water for a bath as it is invigorating, more refreshing and very stimulating to the nervous system, the circulation and the metabolism. It tends to improve the texture, tone, firmness and colour of skin and stimulates the circulation of the blood throughout the body. It stimulates the skin and increases the power of the body to react to variation in temperature. Cold baths should be taken as quickly as possible and body covered immediately afterwards. The first effect produced by taking a coldbath is to chill the surface of the body and that of a shock followed by constriction of superficial blood vessels, but the vessels dilate very soon giving the feeling of warmth and pleasure to the individual.

Warm Bath :—In it the temperature is approximately that of the body. It is of value chiefly to cleanse the skin, particularly when soap is used. It does not have much stimulating effect on skin or the circulation. It soothes the nervous system and may be used to invite sleep, if taken just before retiring.

Hot Bath :—It has a temperature above that of the body. It raises the temperature of the surface of body and causes the bloodvessels of the skin to dilate. It thus causes hyperemia through the skin by withdrawing a large quantity of blood from the interior organs. If a hot bath is long continued, faintness as well as harmful disturbances of the heat regulating mechanism may occur. There is a danger of chilling of the body due to dilated skin vessels and so it is not advisable to go out in the cold.

Vigorous rubbing of body with a rough and dry towel, after taking a bath, is very beneficial, as it acts as a massage to the skin and provides a certain amount of bodily exercise and excites circulation of the blood in the skin. It gives splendid feeling of glow and well being.

Hair :—They should be kept thoroughly clean and should always be kept combed and dressed. Proper and thorough cleansing is required both by men and women. The scalp needs a good blood supply and massaging for a few minutes daily is of great benefit. Fresh air is stimulating and to go without a hat (except in great heat) is good. If the hair are not properly looked after, diseases like ringworm and dandruff may arise. Lice may appear if they are kept untidy and dirty. A dry scalp, seborrhoea sicca, is a condition of "dandruff" *i.e.*, epithelial scales are shed in excess. Oily or soft soap shampoos should be used. An oily scalp, seborrhoea oleosa, is a condition of over

active sebaceous glands. Shampoos should be drying, so they will contain spirit. It is necessary to wash the hair once a week with soap and water. Oil should not be used too frequently. It may, however be used once a week after washing the hair with soap to restore the natural grease. One should always practice to shave oneself, and, as far possible avoid going to barber's shop for the purpose.

The Mouth :—In mouth there are many varieties of bacteria always present and as a rule a healthy mouth is capable of dealing with these. Under conditions of sepsis, however such as carious teeth, septic tonsils, unhealthy mucous membrane or infected sinuses, the stream of bacteria are constantly pouring into the mouth, find their ideal conditions for growth, helped by remains of food. The tongue becomes coated and sordes collect around teeth and lips. Such a mouth may give rise to parotitis, otitusmedia, infected sinuses, pyorrhoea, digestive troubles, infection of respiratory passages and via general circulation, rheumatic conditions and remote septic foci.

The mouth should be well rinsed with some pleasant mouth wash, such as glycerine of thymol and a little of it should be used gargling in the morning and at night after taking last meal or drink.

Teeth :—A tooth is a hard structure composed of dentin and enamel covering the dentin, although resembles bone, but is much harder. The enamel of the tooth, is the hardest tissue in the body. It covers only the exposed surface of the tooth, as within the jawbone the dentin of the tooth is covered with a cement like material, called cementum.

A proper wholesome diet is necessary not only for building of strong teeth, but also to ward off dental diseases. Milk, eggs, tomatoes, guavas, amlas and other citrus fruits including green leafy vegetables rich in vitamin C content should be included in our daily diet. If the diet happens to be lacking in minerals and vitamin C, children may suffer from structural defects of teeth gums and bones. Fully grown teeth also require balanced nourishment for their maintenance.

A set of sound teeth is a valuable asset because it contributes to personal appearance in addition to providing ane fficient chewing apparatus. Defective teeth make difficult or impossible the proper mastication of food and when teeth are infected the health of the body may become seriously impaired. So it is very essential that the teeth should be regularly and thoroughly cleaned to ensure good digestion. They should be scrupulously cleaned at least twice a day, the first thing in the morning and the last thing at night with a brush of moderate hardness. The brush should neither be very hard nor very soft. Any place

between the teeth where the food gets lodged habitually and whence it is not removed promptly and regularly, is quite sure to decay sooner or later. The teeth rarely decay on a fully exposed surface. If there are cavities in the teeth, they should be promptly got filled up. If they are altogether decayed and carious they should be removed at once lest they spread decay to others. When the teeth fall away, artificial teeth should be used, if one can afford to do so. Deposit of tartar upon the teeth should receive due attention and in this case the teeth require scaling or else the roots will become exposed which will eventually make the teeth loose. Children often suffer from caries either on account of deficiency of Vitamin D or due to acid forming bacteria formed on account of fermentation of carbohydrates. Especially amongst childeen, eating of sweets, chocolates, toffees and chewing gums etc., are the promoting causes of dental caries or decay of teeth, because starch and sugar undergo fermentation in the mouth and are converted into acids. Acid acts on the enamel of the teeth, exerting a corroding action, destroying it and exposing undterlying dentine. The microorganisms which are teemine in our mouths, subsequently attack the exposed dentine. Therefore natural fruits in the form of dry fruits such as figs, dates, apricots plums etc., may be given to children, which acts as a nourishing substitutes for candies. Recent studies indicate that sweet and carbonated aerated drinks have also destructive effect on the enamal of teeth, which should therefore also be avoided. In tropics, one has to be very careful about the occurretie of pyorrhoea alveolaris among adults. Bleeding or ulcera an of gums are the precursors of pyorrhoea and dental caries and a dentist should be at once consulted on the appearance of aforesaid symptoms. Pyorrhoea is essentially a disease which is characterised by the formation of pus pockets between the teeth surfaces and gums, where germs reely thrive and become a source of danger to the body. Since germs from the pyorrhoea may threaten the danger of poisoning even the whole body, these germs from the pyorrhoea pockets can reach any part of the body and give rise to conditions like digestive disorders, pain in joints, eye trouble, heart and kidney diseases etc. Moreover, apart from these ailments, pyorrhoea has its social aspects too. Pockets of pus and germs give rise to foul breath which may lead to avoidance of social relations and loss of friends.

A good tooth powder or a tooth paste should be used daily with a brush. A dentifrice containing soap and a fine powder in some form or other assists to some extent the cleansing action of the dentifrice, as these have a sort of polishing action. The disinfectants present in these dentifrices are almost inert.

Several varieties of tooth powders and pastes are sold in the market.

The movement of the brush should not only be from side to side but also from above downwards and inside the teeth. All the inner, outer and biting surfaces should be brushed alike atleast for 5 times. Upper and lower teeth should be brushed downwards and upwards respectively. The chewing and biting surfaces should however be brushed sideways. The use of tooth brush after every meal and particularly at night followed by a hot and tepid water gargles will go a long way to prevent caries and pyorrhoea. The gum tissues may be benefited by massaging them with a finger tip smeared with tooth paste.

The use of tooth brushes is not very sanitary because there is always the difficulty of keeping them clean and the same brush is generally used for a considerably long time. If the tooth brush is to be used, it should be kept dry in a clean glass bottle, when not in use and should be kept in boiling water for some time after use. It should be frequently changed.

In India a green *neem or kikar* stick is used for cleaning teeth which is very good from the hygienic point of view.

The tongue should be cleaned by a tongue cleanser every morning.

The Hands :—These should be kept free from cracks and roughness due to cold wind or constant use of antiseptic solutions. Glycerine (diluted) on account of its action of drawing fluid to it, or some skin cream which will prevent evaporation should be used until cracks heal.

The feet :—These must be kept scrupulously clean by daily bath and careful drying between the toes.

The feet contain many sweat glands, and excessive sweating or *hyperidrosis* necessitates frequent washing and change of socks or stockings. *Bromidrosis* is excessive sweating with offensive odour and soreness of feet. The odour is due to decomposition of sweat. For this condition the feet should be washed several times a day in boric acid solution, dried, dabbed with methylated spirit and powdered with starch and boric powder. Stockings and shoes must be changed each time ; used stockings washed and shoes aired. Cork soles are good and should be washed with a spirit lotion.

Corns :—These are caused by pressure of badly fitting shoes. The epidermis thickens and becomes horny and grows inward to a point. If they occur between the toes, they are kept moist and are "soft corns".

Callosities :—These are formed as a result of pointed shoes. The great toe becomes bent in, producing an angle at the junction of metatarsophalangial joint. The head of the metatarsal is thus a projecting point on the inner border of the foot and is exposed to pressure. A callosity forms on this point of pressure and the bursa underneath becomes chronically inflamed.

These conditions may be avoided by wearing suitable shoes.

The Arch of the Foot :—The inner bony arch should be $1\frac{1}{2}$ inches from the ground. Dropped arch is very painful and is caused by want of tone in the leg muscles with stretching of the supporting tandons and ligaments under the arch. The chief remedies are massage of leg muscles, a built up sole, raised $\frac{1}{4}$ to $\frac{1}{2}$ inch on the inner side ; arch supports.

Nails :—Nails require to be kept clean and should be cut short periodically otherwise dirt will lodge under them and may carry infection. As a majority of Indians eat their meals with their hands and do not use spoons and forks, they should be very careful about the regular cleansing of the nails. The fingers should never be introduced into the mouth and nose. Biting of nails with the teeth is also an unclean habit and is particularly dangerous in tropics, as the intestinal infections are very likely to be carried in this way to the human system. Toenails should be cut horizontally, because if curved, the skin around them will be pressed over the nail and the pressure of the nail on this enfolding skin will cause symptoms usually attributed to "ingrowing toe nail."

Hypertrophied nails :—These are hard, horny, thickened and of a yellowish or blackish colour. They should be treated as soon as condition starts, by soaking in a solution of soda bicarbonate and careful filing.

Eyes :—The eye is the highly specialised receptor of the optic nerve. Its mechanism enables the light waves to reach the optic nerve endings producing sight.

Eyes of the school children should be periodically examined and defects corrected and treated. Children with such defects as myopia and those whose vision is liable to deteriorate should be kept under constant supervision and suitable work chosen for them.

Tears have considerable bactericidal power and are less injurious to conjunctiva than any lotion. Frequent bathing of eyes should not be encouraged. Disinfectant lotions should be used only, when prescribed.

School children should be taught the importance of looking after the eyes. The light in the class room should be satisfactory and the print of the books should be large enough to prevent

eyestrain. All inflammation or accidents to the eye should receive immediate attention. Overindulgence in alcohol and tobacco may lead to blindness.

Sore eye is an infectious disease and fairly widespread in villages all over the country. The infection is present in the discharge of the eyes and is transmitted to the healthy persons through handkerchiefs or towels soiled with discharge by direct contact with the eye of an infected person. Indirectly the infection is spread through flies. The common belief, that it is caused by eating heat producing foods like sweets, jaggery (gur) etc., is not true.

When the germs of sore eye infects an individual, the then transparent covering of the eye called conjunctiva is damaged or it may get hurt by particles of foreign bodies such as dust particles and the eyes may therefore get red and watery. In due course of time a discharge secretes from the eyes which is infective and disease producing.

Treatment :—It consists in washing the eyes with mercury lotion and putting albucid locula or penicillin eye drops. If the eyes are glued together, they should be washed with boric acid lotion made of one teaspoonful of boric acid in two cups of boiled water.

Prevention :—1. One should avoid open cases of sore eye as the disease is highly infectious.

2. Children with sore eye should never be allowed to mix up with the others.

3. Mothers should not use the ends of "dhoties" or "sarees" to wipe away the eye discharge of their children.

4. Flies should not be allowed to sit on sore eye.

5. Persons infected with sore eye should be asked to use separate handkerchiefs, towels etc.

Ears :—They require proper care and attention. The child with running ears is in constant danger of deafness or mastoiditis. Wax in ear, sometimes gives rise to partial deafness, so it should be removed by syringing. If dirt is allowed to collect for some time, it may develop into a large hard plug causing earache, boils and even deafness. No attempt should be made to remove wax by prodding by any sharp pencil, hairpin or any pointed instrument. The best way is to put a drop of warm oil like olive, mustard or coconut oil or glycerine (if available) for a few days. It will soften the hard wax and bring it to the surface which can be conveniently removed by muslin cloth or through syringing. The child with a running ear, or perforation in drum should plug his ear with cotton wool before entering a swimming pool for a bath. The infliction of chastisement by "boxing" a person's ears should be heavily punished.

External Genitals :—The sexualorgans require cleansing even more than most of other parts of the body. In the case of uncircumscribed male organ the foreskin should be retracted in the bath and the secretions washed away. If this is not regularly done, smegma collects and undergoes bacterialdecomposition, with consequent irritation which may lead to masturbation.

In the case of females, the vulva should be washed in the bath. Commencement of menstruation is not a reason for stopping baths but rather calls for their greater frequency. Girls in their childhood should be taught to wipe the anus from before backward and not in the reverse direction so as to avoid introducing faecal organisms into the vulva.

Posture :—By posture is meant the characteristic form in which the body is maintained during its various activities. There is no single good posture known. Goodness of posture consists in alignment of parts in relaxation rather than tension and readiness for action. It may be added that the postures often recommended are stiff, awkward and undesirable. The posture of the soldier on parade is generally taken as an ideal one, but it is a mistaken concept. Correct mechanical use of body permits the internal organs to function efficiently. Good posture is a desirable social asset because of its aesthetic value. The human body makes a poor showing when a part of its anatomy is out of alignment. The causes of faulty posture are :—

1. Inherited structural irregularities.
2. Malnutrition, which brings with it, insufficient muscular power properly to balance the body against the force of gravity.
3. Light or constricting garments worn during preadolescent and adolescent ages.
4. Incorrect foot-wear especially shoes with high heals.
5. Insufficient physical activity which results in muscular insufficiency, and lack of wholesome mental attitude towards life.
6. Occupation which confines the body in an improper posture for many hours a day.

Incorrect posture may interfere with the functioning of the diaphragm, causing it to sag downwards, thus seriously limiting the amplitude of movements. Limiting the action of the diaphragm effects the flow of blood in the large veins because the diaaphragm does not produce the necessary pumping action to cause rapid return of blood. The sagging of diaphragm displaces the heart and abdominal organs by forcing them downward and forward. This may cause circulatory and digestive disturbances and in women may cause displacement of uterus, ovaries and other pelvic organs.

A common and troublesome fault of posture is an increase of lumbar curvature. This condition, known as *lordosis* or "*sway back*", is accompanied by a forward and downward tilt of pelvic organs and protrusion of the abdomen. In this position the last lumbar vertebra rests at too sharp an angle on the sacrum, producing a weak joint at this place. This results in a general strain on the muscles and ligaments of the lumbar region, producing pain; faulty posture is a frequent cause of low back pain which is a common ailment of modern man.

A common structural change in the spinal column is *kyphosis* or "*round back*" which may result from a stooping posture habitually maintained. In this condition thoracic curve is increased, the shoulders and head are bent forward and the chest is flat. Lateral curvature of spine, known as *scoliosis* is a condition in which the spine deviates side ways. It usually starts as a simple functional lateral deviation. If untreated it usually progresses to a double curve and finally the vertebrae and ribs become permanently altered in shape. An individual may have both kyphosis and lordosis at the same time.

Exercise :—Exercise is very essential for the normal growth and development of the body and the perfect maintenance of health. Attainment of bodily strength is essential to achieve success in life. A strong man can work with great vigour and zeal and withstand cares and snares of life better than another who is comparatively weak in constitution.

Effects of exercise :—The effects of exercise on various systems are as follows :—*Respiratory system* :—During exercise the number of respirations is increased and breathing becomes deeper. The pulmonary circulation is quickened and brings into use all the air sacs of the lungs. There is a considerable increase in the amount of oxygen inhaled and carbon dioxide and water vapours exhaled. Outdoor exercise plays an important role in prevention of tuberculosis.

Circulatory system :—Active exercise increases the force and frequency of the heart. Blood and lymph circulates more freely through the whole body. Oxygenation of the blood is very much increased. Lack of muscular activity tends the blood to stagnate in the abdominal viscera. Exercise is beneficial to the normal heart for it keeps it well-nourished, in good tone and prolongs its usefulness.

Muscular system :—The nutrition of the muscles is improved, which contributes to their growth and energy. Without exercise, muscles become pale and flabby and begin to waste and wither away.

Cutaneous system :—There is a marked increase of perspiration owing to the increased action of the skin.

Alimentary system :—Exercise brings about an increased assimilation of food and thus creates a demand for food. The appetite is improved and the action of bowels is stimulated. It plays an important role in the prevention of constipation.

Urinary system :—Quantity of urine is diminished, though the amount of urea and uric acid remains unaltered.

Nervous system :—The mind is refreshed and the powers of observation, precision and tolerance are developed.

Effects of excessive exercise :—It causes either nervous or muscular fatigue or even both. It causes breathlessness, palpitation and hypertrophy of left ventricle and renders pulse small, frequent and irregular. The voluntary muscles become exhausted due to overexertion, suffer in nutrition and naturally begin to wither away.

Exercise should never be carried on upto a stage, when the body becomes entirely exhausted. This fact is of paramount importance, especially when the persons taking exercise happen to be raw or untrained. It should not be too strenuous for the age, physical development and the training of a person. After the age of 40 years, intense exercise may do harm to persons not accustomed to vigorous physical activity.

Exercise should be taken in open air and this is most essential for people with sedentary habits who have to work all the day long in closed buildings. After exercise, a warm bath should be taken to wash the dried secretion from the skin or the body be sponged and should be carefully rubbed with a towel so that the skin may not remain damp and dirty owing to the increased action of sweat glands.

Exercise should be done in early hours of the morning or in the evening. It should not be taken within two hours of a heavy meal. One should not eat too soon either before or after exercise.

The risk of getting chill, however, increases after exercise and therefore the surface of the body, which is exposed during exercise, requires to be covered and protected from undue loss of heat.

Clothing :—Unlike animals man has not developed natural means of protection from heat, cold and atmospheric phenomena. He has neither fur or feathers nor a thick layer of fat under the skin. Thus he has to provide himself with clotning and shelter. Clothing serves as a protective covering. In modern life, in the case of a civilized man only about 20% of his surface is normally exposed to air.

The kind and the extent of clothing worn have a direct bearing on human well being.

The principal objects of clothing are :—

1. To afford protection to the body against effects of heat and cold and to protect the body from external injuries.
2. To assist in the maintenance of body heat.
3. For decency and personal decoration.
4. Clothing influences metabolic change. If insufficient clothing is worn during cold weather the metabolism is increased in an effort to maintain normal body heat. Such loss of heat is in other words loss of energy.

A perfect dress should fulfil the above requirements. The materials used for clothing are derived from animal and vegetable kingdoms. Those derived from animal sources are wool, feathers, fur, leather, silk; whereas cotton, linen, artificial silk or Rayon, Jute, Gutta percha and Indiarubber are derived from products of vegetable kingdom.

Wool :—It is a bad conductor of heat and a good absorbent of moisture for which reasons it is regarded as superior to other materials for making garments for the winter. It imprisons a certain amount of air between its interstices thus preventing rapid loss of heat through it. It forms a valuable garment during winter as it is a much better retainer of heat. Owing to its characteristic property of absorbing moisture, woollen garments should be worn immediately after taking hard exercise when the body is still under perspiration to avoid catching chill due to lowering of the body temperature on account of evaporation of perspiration. Even after heavy sweating woollen garments feel dry, whereas garments made of cotton or linen would be perceptibly wet to touch. Evaporation of water from clothing causes great cooling of the body and cooling from this cause is comparatively less with the garments made of wool, than with any other material. Woollen underdress is particularly suited for the old, delicate and rheumatic persons. The disadvantage of wool is that its fibres shrink and become stiff on washing and thus lose their hygroscopic power, and becomes less absorbent after frequent washing. They are less clean as they show less outward signs of dirt. Woollen garments, being comparatively rough, may cause skin affections when worn immediately next to the skin, but they can be tolerated by habit.

Furs :—They are skins of certain animals. They are very warm and afford protection to the body against cold and wind.

Feathers :—These are used for stuffing quilts, pillows and allied articles, and more often for purposes of ornamentation.

Leather :—It is prepared from skins of large animals; a process of tanning renders the skin flexible. This is used as a

clothing in very cold countries to protect the body against cold, wind and rain, but it cannot be used as an underclothing as it prevents the ventilation of the air next to the skin owing to its being non-porous. It gets stiff when dried after washing. Leather is chiefly used for footwear.

Silk :—It is obtained from secretion of silkworm which covers it in the crysalis stage. It is a bad conductor of heat and less absorbent of moisture than wool, but it is better than cotton. It is soft, smooth and gives a soothing feeling to the skin and is therefore the best material for underwears.

Cotton :—It is a good conductor of heat and does not absorb moisture so it is not a good material for underclothing, for in case of perspiration it becomes wet and consequently may cause chill. It is cheap and durable and does not shrink on washing. In what is called cellular cotton cloth, there are large interspaces between the fibres, which hold air and on account of air being a bad conductor of heat this cloth proves to be warmer than ordinary cloth. It is less hygroscopic than wool.

Linen :—It is manufactured from the flax fibres. It is expensive. It is in no way superior to cotton though pleasant to touch. It is a good conductor of heat and a bad absorbent of moisture.

India-rubber :—It is obtained from the sap of certain tropical trees growing particularly in Africa and the East Indies. It is elastic and impermeable to water hence it is largely used for making water-proof sheets.

Artificial Silk or Rayon :—It is made from cellulose. It is a substitute for cotton and occasionally a substitute for silk both as underclothing and overclothes. The advantages are that it is comparatively inexpensive; it is a slightly warmer material than cotton and comparatively light in weight. It possesses an advantage over silk that it permits ultraviolet rays of light to pass through it. The disadvantages are that it does not wash well and requires very considerable care in dying and ironing.

Jute :—Jute is a coarser material than linen. It is rarely used for clothing but is used for making sacking and some varieties of cheap carpets.

Gutta Percha :—It is similer to Indiarubber and is chiefly used for making the waterproof soles of boots.

Nylon :—It is a synthetic preparation and is a substitute for silk. The advantages are that it is easily washed and dries quickly. It does not need ironing and takes little space in packing. Unless accidently torn or burnt it wears indefinitely. A disadvantage is that the majority of nylons are non-absorbent.

General remarks on clothing :—Clothes should be made of such material as would preserve body heat in winter as well as in summer and should be so designed as would maintain the uniform temperature of the whole body. They should always be changed according to the requirements of different seasons of the year. In hot weather loose, light garments of light or white colour are more suitable as they reflect more of the heat rays of the sun. Black and blue colours absorb heat very readily and so the outer garments made from these colours should never be worn while going out. Children and old people are particularly susceptible to the changes of temperature and are more prone to suffer from congestion or inflammation of the internal organs. Particular care should therefore be taken in matter of their dress. The young and active are however, well able to adapt themselves to climatic variations ; they respond to the stimulus of cold by greater muscular activity.

Great care should be exercised in using coloured clothes, as they are imparted colour with aniline dyes. They irritate the skin, cause skin affections such as eczema and sometimes even poison the system.

Underwears which are worn next to the skin should be clean and changed frequently and should be loose and porous and should absorb moisture well and permit its ready evaporation. They should in no way interfere with healthy action of the skin. The use of flannel underwears next to the skin lessens the liability to attacks of chill.

The same set of clothes should not be used both during the day as well as the night. There should be two sets of garments. The clothes worn during the day should not be kept in the sleeping room during the night.

All tightfitting clothings should be avoided as they interfere with the normal circulation of blood, respiration, digestion and the action of muscles. They interfere with the freedom of movement, make correct posture difficult and impair personal efficiency. Tight lacings, corsets, garters, belts etc., which interfere with the normal blood circulation, should be avoided. Loosefit dress is warmer than a tight fitting one. In the case of a losefitting dress there is a layer of air between the skin and the garments worn on the body, which bears an important influence on the body heat as it is a bad conductor of heat and therefore acts as a separate garment.

A suitable head dress should be worn while going out to avoid the effect of sun's rays. The nape of the neck should also be covered in order to protect the medulla oblongata from the direct action of the rays of sun. It does not matter much for women, as the long hair, which they wear, are quite enough to save them from sunstroke.

Socks or stocking should be always worn with boots or shoes. They should not be very tight and should be washed and exposed to the sun frequently as they smell badly owing to perspiration. Garters worn around the legs will, if too tight or especially if worn above the knee, constrict the blood vessels and impede the venous blood return. Socks with elastic tops are available in the market in these days ; their use is advocated.

A boot or a shoe should conform to the normal outline of the foot and should not squeeze or distort it, thus producing corns. The measurement of the foot should be taken when resting on the ground and always over a thick pair of socks. It is better to have a size bigger than that is actually necessary. The sole should be flexible ; a rigid sole destroys the main action of the foot in the act of walking. The leather should be soft and pliable, consistent with strength. The soles of shoes and boots should be flat, the toes rounded i.e., to say neither pointed nor square, the welts strong and the heels low. Fashionable shoes for women may lack the quality of comfort. Neither anatomy nor physiology supports the use of high heels in the shoes. Children who suffer from weak ankles should wear ankleboots instead of shoes.

Sex Education :—Suitable education in elementary biology should be given to every child, so that he or she can understand the significance of reproduction, heredity and evolution. Guidance on question of conduct should be given to young people before they leave the school. The whole matter should be openly discussed and although fear should not be utilised, it is advisable to explain the meaning and consequences of venereal diseases.

The policy of silence about sex matters to which young boys and girls have been so much subjected, generally leads to crude and loutish notion or strange or fearsome concepts of sexual organs and sexlife. The hygiene of sexual organs and the sex problems should be grasped with frankness by the young persons of today although it was quite impossible in the latter decades of the nineteenth century.

Before the onset of puberty, the bodily changes which will slowly occur should be explained. The first menstruation in a girl or the first nocturnal emission in boy, if they happen without warning, may inflict lasting mental injury. The number of nocturnal emissions varies greatly but up to four a month need not be considered abnormal. At a later stage the question of sexual intercourse must be dealt with.

There are some problems after marriage. A few words of timelyadvice by the parents or family doctor or friends to a prospective bride or bridegroom can do much to save a marriage from shipwreck, for it is absolutely true that a marriage may be

ruined and the couple made unhappy and miserable for years or for life on the first night of the honey-moon. If the bride goes to her marriagebed ignorant of the nature of the sexual act, the first intercourse is little more than a rape. Any mother who allows her daughter to undergo such an experience is little short of criminal. The bridegroom should also be informed about the difficulties of a bride's first intercourse, and if he loves her, will be prepared to overcome his desires and to woo her afresh with gentleness and not seize her as of right.

In youth the temptation to illicit intercourse is strong. The youngmen and youngladies should be advised to keep their bodies undefiled for their future wife or husband. Hard and strenuous work, exercise, pride in a healthy body and avoidance of evil companions, suggestive literature and alcohol, all help in the fight of mind and body against sexual instinct.

CHAPTER XII

OFFENSIVE TRADES & OCCUPATIONAL POISONING

According to Collier, Industrial Hygiene has been defined as the study and application of the principles and practice of modern medicine and hygiene to the special problems of health and disease as they are met-with in industry.

Certain trades, which chiefly deal with the animal matter, require to be supervised by sanitary officials, as due to the nuisance of smell and effluvia which is given off from them, they might act injuriously on the health of the people engaged in that trade and those living in the locality, where that trade is carried on. Under the circumstances the municipalities in the towns have framed byelaws for the proper carrying on of these trades, which are as follows ;—

1. Keeping of Animals ;—In rural areas keeping of animals is not likely to cause much nuisance. It is only in towns, that they may prove to be a source of nuisance to the inhabitants of the house where the animals are kept and to the persons residing in the neighbourhood of that house. If the animals are kept in overcrowded, illventilated and badlydrained localities in towns then owing to the decomposition of food grains and putrefaction and soakage of urine, dung, etc., in the ground, it might serve as a breeding place for the flies etc. The stables for keeping animals should be built at a distance of about 100 ft. away from the inhabited area. These should be built on hygienic principles. The discharges should be received in covered vessels and should be washed and cleaned daily.

In pig sties the food should be stored in impervious vessels provided with proper covers. Generally the pigsties are maintained in a very filthy state.

Keeping of poultry *i.e.*, hens, ducks etc., in a house is also a source of nuisance and people living in small houses should not be allowed to keep these in their houses for breeding purposes.

2. Slaughtering of Animals :—This should only be allowed in public slaughter houses for which following points should be noted :—

1. A slaughter-house should be situated outside the town away from the inhabited area (under no circumstances it should be situated within 100 ft. of the inhabited area).
2. It should be open to outside air on at least two sides.
3. It should be above the ground level and there should be a compound around it.
4. There should be no living room over the slaughter house.

5. There should be available an abundant supply of water.
6. The floor should be pucca and made of an impermeable material having a proper slope and a channel leading to a gully provided with a trap to prevent emanation of offensive gases from entering the slaughter house.
7. The walls should be made of impervious material. The corners of the slaughter-house should be rounded.
8. There should be no direct communication between a watercloset or privy with the slaughter-house.
9. Wiregauze doors and windows should be provided with selfclosing mechanism.
10. The employees of the slaughterhouse should wear overalls and should be clean and tidy.
11. Persons suffering from infectious diseases should not be allowed to handle meat.
12. Butchers who handle diseased meat, should wash their hands with some disinfectant solution and all instruments should be thoroughly sterilised after use.
13. All refuse, offal meat, manure, etc., should be placed in vessels which are properly covered. Skins, etc., should be removed as soon as possible after slaughtering of the animals.
14. Dogs should not be allowed to roam about in or around the slaughter-houses.

3. Blood boiling :—Blood collected from slaughterhouses is utilised for the following purposes :—

(*a*) Preparing blood manure.
(*b*) Refining sugar.
(*c*) Making blood albumin.
(*d*) Manufacturing turkey red pigment.

Blood is boiled with an admixture of commercial sulphuric acid to bring it into thick consistency. On boiling it emits sickening smell.

Precautions :—(1) Blood should be collected and stored in clean and airtight vessels to prevent the escape of offensive gases.

(2) The boiling should be done in a place where suitable arrangement is made for the discharge of gaseous products through a chimney, the height of which should be above the height of inhabitable buildings of the vicinity.

(3) The floor, vessels, etc., should be kept scrupulously clean.

4. Bone Boiling :—It is done for the following purposes :—

(*a*) Preparation of phosphatic manure particularly for tea gardens.

(*b*) Preparation of gelatine, glue and fat.

(*c*) Manufacture of handles of knives, etc.

Precautions :—(1) The premises should be cleaned daily and all refuse should be collected and removed therefrom.

(2) The raw bones should be stored in a suitable shed.

(3) Boiling should be done in steam jacketed pans provided with a very high chimney for emanating offensive gases.

(4) Walls and floors of the room where boiling is done should be kept in good order and the walls should be limewashed twice a year.

(5) Fresh and dry bones should be treated with lime before they are stored.

5. Gut Scraping :—It is done for the purpose of making sausageskin, catgut, etc. The small intestines of pigs and sheep are first washed, cleaned and softened by soaking in salt solution for a few days and then scraped with a wedge shaped piece of wood, until only a little of the muscular coat and the peritoneal covering are left. These are finally washed and dried. The process is very offensive.

Precautions :—(1) The floors and walls where gutscraping is done should be made of impervious material.

(2) Proper drainage arrangements should be provided.

(3) The tables should have marbletops.

(4) Prompt removal of the waste materials.

(5) Proper washing and cleansing of the premises.

(6) Prolonged storage should be avoided

6. Fat and Tallow Melting, Soap Manufacturing :—The fats are derived from beef, mutton, pork, kitchenwastes, etc. It is utilised in the manufacture of candles, soaps, leather dressings and grease for lubricating machinery. In the soap manufacturing process, fat is boiled with an alkali. These are melted in the pans over open fire or free steam or in steam jacketed pans.

Nuisance of obnoxious smell may arise from :—

(*a*) Improper conveyance or storage of material.

(*b*) Storage of residue.

(*c*) General filthiness and unsuitability of the premises due to vapours arising during the process of melting or boiling of the fat.

Precautions :—(1) The process should not be carried out near the populated locality.

(2) By use of steam jacketed pan the nuisance of foul smell is considerably lessened.

7. Fell Mongering, Tanning or Leather Dressing :—All these processes are very offensive. So these trades should not be carried out near a thickly populated locality. The building where tanning is done should have a compound wall at least 6 feet high. All offensive materials should be conveyed in non-absorbent, covered receptacles and should be kept in a special closed room ventilated by providing air shafts. There should be satisfactory method of disposal of dirt, scrapings of flesh and waste water.

8. Brick and Lime Kilns :—Organic effluvia, carbon dioxide, carbon monoxide, sulphur dioxide and hydrogen sulphide are given off. These should be installed far away from the inhabited locality. The brick kilns should be provided with proper flues and should be worked at night only. Availability of a sufficient amount of water is necessary in the vicinity of the brick kilns.

9. Smoke Nuisance :—Large volume of smoke comes out from the chimneys of factories and the dwellinghouses. This smoke gives rise to a great nuisance, which can be prevented by installing all factories away from the inhabited area and by having properly constructed furnaces, boilers and chimneys and as well as by substituting gas or electricity for coal for heating purposes.

10. Paper Making :—Paper is manufactured from such substances as cotton, linen, rags, wastepaper, straw, bamboo, esparto grass, etc. Nuisance is caused chiefly by alkaliwaste, which should not be allowed to run in any stream. The collection and storage of the raw material is also a source of danger to the health.

11. Rice Mills :—The effluent in which paddy is soaked is putrescible and gives out foul smell. It should not be discharged near the inhabited area and should be chlorinated before allowing it to run into any river or a stream. Steps should be taken to install necessary protective machinery against the dissemination of dust.

12. Oil Mills :—They should be well-lighted and ventilated. Their floors should be made of impermeable material. The oil and crushed seeds should be stored in covered vessels. There is a nuisance of smell from the oil seeds, oil cakes and the noise produced from the running of the propellers and therefore these mills should be installed sufficiently away from human habitation.

13. Sugar Factories :—The factory washings containing cane sugar ferment and decompose readily and give out foul smell.

So the effluent should be chlorinated before it is used for irrigation purposes. It should not be allowed to run into a river as it will pollute the water and may kill fish.

14. Dusty Trades :—Certain industries give rise to considerable amount of dust, which cause various forms of bodily ailments and troubles. Constant inhalation of dust gives rise to pneumoconiosis, coaldust anthracosis, stonedust silicosis, asbestos asbestosis, iron siderosis, and cottondust byssinosis. They also cause diseases of throat, eyes and skin. Various microorganisms *e.g.*, of tuberculosis and anthrax are conveyed through them.

Industrial dust may be mineral, vegetable or animal in origin. The dusty trades and occupations are jute flax, textile industries, lead, copper, iron, cement and lime works, handling of leather, silk, wool, cotton, paper and drilling, cutting of stones, bones horns, flour mills, etc. The most dusty processes are carding and spinning.

Workers in jute, cotton and flour industries suffer from breathlessness, develop symptoms of asthma and weakness of chest.

Millstone cutters, stonemasons, pearlcutters, sandpaper makers, knifegrinders, hairdressers and furdyers generally suffer from lung diseases.

Workers in gold mines inhale rockdust and suffer from silicosis.

Matchmakers suffer from necrosis of jaw due to inhalation of fumes of phosphorus.

Those who prepare glass mirrors suffer from mercurial poisoning.

Workers in lead and plumbers are exposed to lead poisoning.

Precautions :—The amount of dust may be lessened by the use of oil, water or steam.

The nuisance caused by the escape of dust particles should be prevented by providing special boxes for the machinery. The dust should be removed by special means *e.g.* by suction fans or by special ventilating arrangements. Extraction tubes or magnetic shields may be used. In addition to these the workers should use respirators.

Wool Sorter's Disease :— It occurs in persons who are employed in those industries which deal with wool, cattle hair, hides and skins. It is a form of bloodpoisoning.

Precautions :—Bales of wool or hair must be opened after immersing in water. Rooms should be provided with exhaust fans. Refuse from woolsorting should be collected in covered receptacles and burnt away. Persons having cuts or wounds on

their bodies should not be allowed to work there. Wool should be disinfected first by formalin before handling. Food should not be taken in the work rooms where wool, hair or fibres are handled. There should be a provision of proper washing accommodation also in that room.

OCCUPATIONAL POISONS

1. Lead Poisoning :—It is one of the commonest industrial diseases. Lead is a cumulative poison. It finds entrance into the system by :—(*a*) Swallowing minute particles of lead which are converted by the hydrochloric acid of the stomach into a soluble chloride of lead.

(*b*) Inhaling dust and fumes of molten lead.

(*c*) Absorption from the skin in handling lead as in paint manufacturing concerns.

The chief industrial occupations in which lead poisoning is liable to occur, are white and red lead works, pottery manufacture, electric accumulator works, enamelling and painting industries, smelting metals, glass and file cutting, manufacture of lead pipes and plumber supplies such as solders, gun shots manufacture, type foundaries, etc.

Chronic form of lead poisoning is more common than acute one. The chief symptoms are constipation, colic, blue line on gums, anaemia, rheumatic pains in muscles and joints, paralysis, especially of extensors (dropped wrist and dropped foot are common). There may be arteriosclerosis, interstitial nephritis, lead insanity, etc.

Precautions :—Cleanliness of hands and finger nails, thorough washing of hands and rinsing of the mouth before eating. Workers should not take their food in the work rooms. Workers should use separate clothing while at work. The workshop should always be kept clean, wellventilated and free from dust. Arrangement should be made for rapid and complete collection of all fumes and dust which should be conducted to condensing chambers. Since inhalation of leaddust is more dangerous than swallowing it, adequate exhaustventilation should be compulsorily provided in all dusty processes. Sand papering, lead painted surfaces for obtaining a better finish is dangerous on account of evolution of dust. The use of waterproof sandpaper which can be used is therefore recommended for the purpose. Handling of poisonous materials should be reduced to the minimum by substitution of mechanical methods. Women and children being particularly susceptible to leadpoisoning should not be employed in lead factories. Pregnant women are liable to abortion and stillbirths. Workmen should take drinks containing minute doses of sulphuric acid and they should take plenty of milk (owing to its high calcium content) and avoid taking alcoholic

liquors. Workers should undergo medicalexamination after short periods. Factories should be provided with a separate cloak room and a mess room having adequate washing accommodation.

2. **Mercury Poisoning**:—Mercury or its compounds are used in the manufacture of barometers, thermometers, vermillion and in trades like bronzing, guilding, in manufacture of electric meters and lamps, felt hats and fur dressings. It may find access into the body by similar channels as lead.

Symptoms of mercury poisoning are stomatitis, salivation, foetid breath, sponginess of gums, falling out of teeth, anaemia, muscular tremors and paralysis.

Precautions :—To be observed against mercury poisoning are the same as in the case of lead poisoning. Workmen, while working should wear overalls. Attention should be paid to proper care of mouth and teeth. The floor should be made of asphalt and should be designed and sloped in such a way that the spilt mercury is collected easily and effectively. Work should be conducted in the rooms at a temperature below 60°F and so far as possible the metal should be kept covered so that the volatilisation of mercury may be minimum. Rooms where dust and fumes are evolved should be provided with exhaustventilation. The vapours may be neutralised by spraying floors with ammonium hydrate.

3. **Phosphorus Poisoning**:—Phosphorus is used in the manufacture of matches and affects those workers who expose themselves to its fumes.

Symptoms of Chronic Poisoning :—These are headache, loss of appetite, anaemia, dyspepsia, hepatitis, necrosis of the jaw, albuminuria, bronchitis and insomnia. The long bones become brittle and are liable to fracture–a condition known as *fragilitas ossium.*

Precautions :—Special attention should be paid to the teeth. Mouth should be washed frequently with an alkaline solution. Turpentine is recommended as an antidote for phosphorus, so it should be inhaled. Work should be done in wellventilated rooms and if possible in the open air. Work rooms should be provided with exhaust fans or flues to drive away all fumes of phosphorus. Yellow variety is more poisonous so its use should be discouraged whereas sesquisulphide of phosphorus being harmless, its use should be encouraged.

4. **Arsenic Poisoning**:—Occurs in those persons who either handle arsenical pigments *viz.*, paris green, inhale arsenical dust from wall papers or those who mount or cure skins of animals. Arseniuretted and phosphuretted hydrogen are given off

from damp ferrosilicon—an impure alloy of iron and silicon which is used in certain metallurgical processes.

Symptoms :—Painful eruptions on the mucous membranes of air passages and eye passages causing conjunctivitis and oedema of eyelids, vomiting, diarrhoea, painful neuritis and anaemia. The salts of the metal act as local irritants, particularly around the mouth, nose and armpits.

Precautions :—The wall papers should not be used. The use of arsenical dyes should be discouraged. The work room should have suitable condensing chambers. Workers should not take their meals in the work rooms.

5. **Brass Founder's Ague** :—It is the term applied to a condition resembling malarious ague, but usually apyrexial, which affects persons who are exposed to the fumes from molten brass or even brass dust. Brass founders suffer from bronchitis, asthma, and a disease called "Brass founder's ague" characterised by rigors, fever, and sweating owing to inhalation of fine metal, particles of zinc, magnesium or copper oxides.

The work room should be wellventilated and should be provided with extraction fans. Females should not be allowed to work in the brass works. Protective clothing should be provided to workers.

6. **Chromate Poisoning** :—Persons engaged in manufacture of chromate and bichromate of potassium, and sodium suffer from chronic ulcers on knuckles or at the root of nails. Chromate poisoning particularly affects nasal septum of the workers suffering from it.

The preventive measures are, frequent cleansing of the premises, provision of local exhausts to draw off the mist, the careful dressing of abrasions, the use of ointments or rubber gloves and the wearing of masks. Workers should be provided with facilities for baths and ablution.

7. **Tobacco Poisoning** :—The persons working in the manufacture of tobacco, suffer from nausea, giddiness and irritation of eyes.

POISONOUS GASES AND FUMES

1. **Carbon Dioxide** :—It is given off in the process of fermentation, in breweries, paperworks, limekilns, sewers and certain chemical processes. It occurs in mines, lime and brick kilns, in deep wells and cells etc. Distressing symptoms arise, if the percentage of carbon dioxide increases more than 7 to 8%.

Its symptoms are headache, chilliness, and symptoms of dyspnoea, leading to unconsciousness and death. Oxygen inhalation should be resorted to as a remedial measure.

2. Carbon Monoxide :—It is a colourless, odourless and tasteless gas produced by the combustion of carbonaceous material. It causes distressing symptoms if present to the extent of 0.1%, where as exposure to the gas if present in the strength of 0.4%, may cause death, by combination with the haemoglobin of the red blood cells to form a stable compound called carboxy-haemoglo-bin. It is also found in "after damp" of mines. This gas is found in gas works, blasting furnaces, coke ovens, cement and brick kilns, process of soda manufacture, in motor exhausts and in manufacture of wood charcoal.

The gas is most poisonous and acts on the tissues of the body by preventing oxygen from reaching upto them.

Symptoms :—In acute cases loss of motor power and loss of consciousness occurs. There may be attacks of pneumonia accompanied with haemorrhage into central nervous system.

In less acute cases :—Dizziness, vomiting and palpitation of heart are seen. Sequelae are paralysis, loss of memory and in a few cases dementia. The blood assumes cherry red colour. In order to eliminate the danger of carbon monoxide poisoning, provision of free ventilation and prevention of leaks is essential. Workers engaged in dangerous places *e.g.*, where leaks are occurring, should invariably wear oxygen helmets. Those affected should be treated with artificial respiration (Shafer's method) and also oxygeninhalation, if possible.

3. Carbon Bisulphide :—This is used in the manufacture of waterproofs as a solvent of fats, coutchouc, India rubber, phosphorus, sulphur and in the preparation of cellulose for artificial silks. It is very poisonous even in minute doses as air containing one part of gas in one million parts of air is considered to be toxic.

Symptoms of Poisoning :—They include headache, giddiness, tremors, hysteria, atrophy and fatty degeneration of muscles and connective tissues with loss of fat. It also causes haemolysis. In some cases neuritis or paralysis of muscles occur. There may be mania or dementia.

Precautions :—Workers should be examined medically once a month. They should not take their meals in work rooms. Carbon bisulphide should be kept in covered vessels and fumes arising from them should be removed by extraction fans.

4. Sulphuretted Hydrogen :—This gas has a peculiar smell and is dangerous to health even if present in the ratio of 0.2 to 0.4%. It is found in chemical works, in cleaning of boilers, in soap factories and in treatment of sulphuric acid to remove traces of arsenic therefrom. It is some times also found in sewers, privies, filth and manure heaps. It is called "Stink

damp" in mines where it is produced from the decomposition of pyrites.

Symptoms :—They are headache, gastric disturbances, nausea. When inhaled for longer periods it causes convulsions, paralysis, coma and death. For remediable cares, the measures are artificial respiration and the administration of oxygen.

5. **Sulphur Dioxide Poisoning** :—It may occur in those workers who are engaged in the manufacture of sulphuric acid, process of ore burning and bleaching of cotton.

Symptoms :—Suffocation, dyspnoea, coryza, cough, opacity of cornea, cynosis, opacity and convulsions.

6. **Arseniuretted Hydrogen or Arsine** :—This gas is found in chemical and galvanising works. Cases of poisoning have occurred from the use of commercial acids and also during roasting of various metallic ores.

Symptoms :—Toxic jaundice or haemolysis may occur. There may be vomiting, haemoglobinuria, haematuria and suppression of urine.

Remedial measures are the administration of oxygen and transfusion of blood, together with glucosaline and diuretics. Free ventilation should be the rule, in stores containing arseniferous materials.

7. **Chlorine and Hydrochloric Acid Gas** :—These evolve from alkali works, bleaching works, etc.

Symptoms :—They are spasm of the glottis, cough, dyspnoea, bronchial cattarh, respiratory distress and immediate death due to pulmonary oedema. The precautionary measures are the maintenance of gastight plant, the wearing of masks and the routine medical inspection of workers.

8. **Ammonia** :—It is evolved in ammonia works, in the silvering of mirrors, tin plating, in manufacture of ice refrigerating plants, etc.

Symptoms :—Chronic bronchial cattarh, conjunctivitis, salivation, paroxysmal cough but rarely suffocation and death.

9. **Benzene** :—It is a coaltar derivative and is used in rubber works, drycleaning works, manufacture of aniline, etc., and explosive industries. The vapours of the gas may be inhaled and substances like nitrobenzol or trinitrol (T.N.T.) may be absorbed through the skin.

Symptoms :—Flushed face, nausea, vomiting, pain in abdomen, giddiness, headache, cynosis, stupor, coma and death. In chronic cases, fatty degeneration of heart, liver, and kidneys is common. Prevention consists in provision of exhaust ventilation

and the use of overall protective gloves, aprons etc. Moreover, scrupulous personal cleanliness should be observed.

10. Aniline :—It is used in the manufacture of dyes.

Symptoms :—They are due to cumulative action of the aniline on human system. They are eczematous ulcerations, cough, tachycardia, nervous symptoms, insomnia, blindness and malignant disease of bladder.

The preventive measures are local exhaust ventilation, mechanical manipulation, periodical medical examination and alteration of employment. Washing facilities should be made use of and protective clothing worn.

Rules Regarding the Welfare of Industrial Workers :— They are as follows :—

Hours of work :—The Royal Commission of Labour in India in 1931 has fixed the following working hours for the workers in the factories :— *For men*, 54 hours weekly and the daily limit ten hours.

For women the restperiod should include the hours between 10 a.m. to 5 p.m.

For children the work should not exceed 7½ hours per day and the restperiod should include the hours between 7 a.m. to 5-30 p.m.

In view of climatic conditions, poor physique and nutritional deficiencies, the workers should have a mid-day rest for at least an hour exclusive of working hours. The night duty should not be continuous for more than a fortnight.

Periodic inspection of the workers specially the children, adolescents and female wokers should be carried out by a surgeon. The sanitary inspection of the premises should also be periodically carried out.

Accidents are very common in factories and take a high toll of human life. Certain diseases and injuries are common to workmen *e.g.* spinal curvature, varicose veins, injuries to eyes due to pieces of stone or metals, impairment of vision, eye strain etc. These accidents should be prevented as far as possible and adequate care should be taken to safeguard the lives of workers working in the factories. Fencing should be done around the dangerous parts of the machinery and guards should be provided where most dangerous type of machinery is installed.

The best results are obtained from those methods where the protective apparatus is not under the control of the workman. There should be a provision of resuscitation equipment and means of escape in case of fire.

Lighting :—Adequate natural lighting should be arranged in factories, varying with the nature and character of work. Artificial lighting is undesirable, since it is more productive of visual fatigue than natural lighting. When artificial lights are used, preference is to be given to electric light. Fluorescent lighting is particularly suitable as it is economical and avoids casting shadows and contrasts. Insufficient lighting increases incidence of accidents, injures eyes and leads to general insanitary conditions. In mines, defective lighting gives rise to nystagmus among workers.

Injuries to the eyes may be due to splashes of dangerous chemicals entering the eyes or may be due to rays harmful to the eyes. It is very essential that suitable goggles be worn while working. Suitable guards should be fitted for machines.

Ventilation :—Adequate ventilation is necessary. Cross ventilation be provided. Air stagnation and pollution of atmosphere should be avoided as they give rise to industrial fatigue. Any defects of ventilation in a factory will be productive of an increased liability to loss of time due to respiratory complaints such as cold and influenza. In large factories some times mechanical system of ventilation is provided.

Cleanliness :—Proper cleanliness of the premises and the surroundings of the factory should be maintained. It must be specially attended to in dusty trades and in textile mills. Many a time vacuum cleaners and dust removing plants are installed in some factories. Provision of washing places with adequate supply of water is obligatory in dusty trades. Workers must attend to bodily cleanliness and use protective clothing.

Drinking Water :—An adequate and wholesome supply must be supplied in all works; the best provision is that of a bubbling fountain so arranged that the only drinker's lips do not come in contact with the spout; the common drinking tumbler spreads infection.

Sanitary Accommodation :—Must be provided at the rate of one convenience for every 25 females and for every twenty five upto 100 males; above which number of the proportion may be reduced. Adequate number of urinals be provided.

Education of Workmen to the Nature of Dangers :—All workmen should be educated to know about the danger of the material with which they come into contact. Precautionary placards should be fitted at prominent places. Workers should be imparted training in First Aid and the method of artificial respiration. They should be familiar with the precautions to be observed if they are handling some poisonous material.

Humidity :—There should be kept a wet and dry bulb thermometer in every factory. Working in humid sheds causes deteriorating effect on the health of workers.

Other factors requiring consideration are :—

(*a*) Proper housing.
(*b*) Good nutrition, maintenance of canteens, regular meal hours ; control of sale of food.
(*c*) Maternity benefit to female workers. Six weeks leave for women both before and after confinement.
(*d*) Creches or day nurseries for children of the working women.
(*e*) First aid training of workers.

CHAPTER XIII

INFECTION, CARRIERS OF INFECTION, ITS PREVENTION AND CONTROL

Infection :—By infection is meant the introduction into the body of some pathogenic microorganisms which are capable of multiplying within it, at the expense of the host without coming into contact with the patient. They produce toxins. Diseases depending on such infection are called infectious diseases.

Infectious Agent :—A microorganism, bacterium, protozoon, helminth, spirochete, fungus virus or other capable of producing infection and under favourable circumstances of host, and environment having the capacity to produce infectious disease.

Contamination :—The presence of an infectious agent on a body surface or on or in an inanimate object or substance.

Contagion :—It means the material which carries the infection *e.g.* in smallpox contagion is carried through air. In syphilis a close contact is necessary for infection to take place.

Fomites :—They are substances capable of absorbing, retaining or transferring infection. They refer to inanimate objects, like clothing, bedding, etc.

Host :—A man or other living animal, including birds and anthropods, affording under natural condition, subsistence or lodgement to an infectious agent. Some protozoa or helminths pass successive stages in alternate hosts of different species. Hosts in which a parasite attains maturity or passes its sexual stage are primary or definitive hosts; those in which the parasite is in a larval or a sexual state, are secondary or intermediate hosts.

Epidemic :—When an infectious disease becomes largely prevalent where it previously did not exist, from a common source, it is called an epidemic.

Endemic :—When an infectious disease is more or less prevalent in a locality or a community, it is called endemic. It is local and recurs with varying degree of virulence *e.g.*, cholera in lower Bengal.

Sporadic :—When a disease occurs at intervals and in single, scattered or isolated cases, it is called sporadic.

Pandemic :—When an epidemic is very widely spread over a large tract, from country to country or over whole of the world, as influenza of 1919, it is called pandemic.

Epizootic :—An infectious disease in lower animals is known as epizootic. This term is analogous to epidemic.

Exotic :—When a disease is not urually present in a locality but is introduced from abroad it is called exotic.

Contact :—A contact is a person who has been exposed to the risk of infection as a result of direct or indirect association with a case of communicable disease.

Incubation Period :—After a person is infected, the germs remain latent and the person does not develop any symptoms for a time, *e.g.* the time, from the reception of infection or poison until the symptoms of the disease appear, is called "Incubation period". The duration of period varies in each disease and during this period the patient may remain perfectly healthy. The length of incubation period depends upon the following facts :—

(*i*) Partly on the amount of poison entering the system at the time of infection.
(*ii*) Resistance of the patient.
(*iii*) Virulence of the virus.

Period of Infectivity :—It is the duration of communicability of the disease. Practically the power of imparting infection begins with the appearance of first symptom, and lasts until the patient has recovered absolutely, *i.e.*, until all the special appearances of the disease have disappeared. The length of period of infectivity depends upon a variety of circumstances which differ in each case, *e.g.*, in typhoid and cholera, bacilli continue to be discharged from the body for a very longer period, than it is to be thought. Hence such person becomes a real source of danger to the community for he may go about spreading the germs of the disease for months after he has been restored to perfect health.

Disease Carriers :—These are persons who harbour pathogenic microorganisms of a specific infectious disease without manifesting any signs and symptoms of the disease but who are still able to infect other individuals. They are divided into four groups :—

1. *Precocious or Incubation Carriers* :—They are the persons during the incubation period of the infectious diseases. There is little evidence that such carriers, if they exist, exert much influence in propagation of infections.

2. *Contact Carriers* :—These are persons who are in contact with a case of an infectious disease and carry microorganisms morphologically identical with those causative of the disease ; such organisms are not necessarily virulent or slightly virulent. They may also be called temporary carriers.

3. *Convalescent Carriers* :—Persons who continue to harbour during convalescence, the organisms, which caused the disease. They are sometimes called acute carriers

4. *Chronic Carriers* :—Persons who harbour infective organisms for a long period after recovery from the disease (*i.e.*, more than 3 months), the period of infectivity being often only displayed intermittently, with the intervening periods of infectivity. There is a good ground for concluding that the chronic carriers are far more dangerous than the temporary or acute carriers.

Channels of Infection :—The infection enters the body hrough :—

(*a*) *The skin, i.e., by inoculation* :—The contagia of anthrax, vaccinia, tetanus, rabies and glanders pass through skin. Abrasion helps infection from syphilis, gonorrhoea, etc. The biting insects, convey infection through bites on the skin, as in malaria, yellow fever, dengue, filariasis, plague, sleeping sickness, etc.

(*b*) *By inoculation* through the respiratory tract, through air pollution. Its dissemination takes place through *droplet infection*. During coughing, speaking loudly, sneezing, etc., droplets of sputum are sprayed into the air in minute particles which contain germs of infectious disease. When they are inhaled by a healthy person, the infection is conveyed *e.g.*, diphtheria, whooping cough, measles, influenza, common cold, pulmonary tuberculosis, etc.

The only air-borne diseases are smallpox and measles.

(*c*) *By ingestion* through the digestive tract :—They are conveyed through the infected articles of food and drink, and also through insects, *e.g.*, cholera, entericfever, diarrhoea and dysentery. Malta fever is carried through goat's milk.

Modes of Transmission of Infection :—These are :—

1. *Direct* : *i.e.* without intervention of intermediary host. This is also known as contact infection. The discharges from a patient are conveyed to a healthy person by droplet infection as tuberculosis, measles, influenza, common cold, whooping cough etc. Contaminated hands and fingers spread diseases like cholera, dysentery and typhoid. Another group of diseases is the result of physical contact of moist surfaces of genitalia, the so called "touching diseases" and includes syphilis, chancroid and granuloma venereum.

2. *Indirect* :—Infection may be transferred indirectly through the agency of a third person through a vector or vehicle. These may be :—

(*a*) *Inanimate* :—

(*i*) Contaminated objects such as dishes, utensils, toys, books, slatepencils etc.

(*ii*) Contaminated foods which transfer typhoid, diarrhoea, dysentery, cholera etc:

(*b*) *Animate* :—Insects, which are capable of carrying infection from one host to another as malaria, plague etc.

3. *By carriers* :—The human carriers may be of two kinds *i.e.*, temporary and chronic carriers. The temporary carriers may be again differentiated into healthy transient carriers, incubating carriers and convalescent carriers. The chronic carriers provide one of the most difficult problems to control in the case of infectious diseases.

Quarantine :—This means arrest of communication with infected places except under certain restrictions. This usually consists in detaining healthy travellers for a specified time after their departure from an infected place. The time of quarantine should cover at least the longest incubation period known of the particular disease. It may be :—

(*i*) *Inward Quarantine* :—When quarantine is imposed on a healthy town for its own protection.

(*ii*) *Outward Quarantine* :—When it is imposed on an infected town for the protection of the surrounding area.

(*a*) *International Quarantine* :—It means compulsory isolation at the port, of all persons coming from an infected place or persons who have been in contact with the case of an infectious disease, against which quarantine has been imposed.

(*b*) *Scholastic Quarantine* :—Children from an infected house during the period of quarantine should not be permitted to attend school until the last case in the house has ceased to be infectious.

(*c*) *Domestic Quarantine* :—All persons, particularly children should be strictly prohibited to enter an infected house. All members of such an infected house should be kept under watch for a period equal to the incubation period of that disease.

Surveillance is the practice of close supervision of contacts for the purpose of prompt recognition of infection or illness but without restricting their movements.

Epidemiology :—The word epidemiology is derived from the Greek words "epi" upon and "demos" the people. It has to do therefore occurrences to human populations or communities or taken literally it relates to occurrences of any kind. But with the passage of time the term epidemiology is being used now as the study of origins, development and distribution of the epidemic infections. An epidemic is probably due to the association of a number of contributory factors such as :—

1. Increased virulence of the casual organisms.

2. Increased susceptibility of a large proportion of the population.
3. Increased facilities for the transmission of infection.

The characteristics of an epidemic spread by direct personal contact or indirect contact (fomites) are :—

(*a*) The development of a series of cases from previous cases.
(*b*) Irregularity of occurrence in time and place.
(*c*) The non-explosive onset with a slow spread and a gradual rise and decline.

Stages of an infectious Disease :—All infectious diseases pass through five stages which vary in duration in the different diseases. The stages are :—

1. Inocubation period.

2. *The onset or Prodromal stage* :—This commences when the first symptoms appear or are experienced by the patient and continues until the condition is well developed. It is sometimes called invasion period, but the term is misleading as it is apt to be confused with the invasion of the patient by the organisms.

3. *The Period of Advance or Fastigium* :—All the symptoms are now increasing in severity, until a climax or acme is reached. In those diseases associated with eruption the rash becomes fully developed. The term "fastigium" is sometimes reserved for the climax only, not for a period as a whole and it lasts as long as the high temperature is maintained.

4. *Period of Defervescence* :—All the symptoms are now decreasing in severity and the patient is feeling much more comfortable.

5. *Period of Convalescence* :—The patient has completely overcome the invaders and their toxins, but he is suffering from a variable degree of exhaustion and a certain amount of tissue waste. He needs fresh air, good food, tonics and graduated exercises until his health is fully restored.

Susceptible :—A person is susceptible who has not acquired immunity to a particular disease by a previous infection or vaccination.

Immunity :—By this term is meant nonsusceptibility (resistance) to a given disease, or a given organism. Thus if a number of persons are simultaneously infected with the same strain of an organism under similar conditions, some may happen not to develop the disease *i.e.*, they are nonsusceptible to it or in other words are resistant to infection, while others may develop the disease in various degress of severity from mild to extremely severe. Those who do not develop the disease are called immune or nonsusceptible.

Tolerance :—By this term is meant partial or limited form of immunity.—

Natural Immunity :—It is the resistance offered by the body under the normal conditions without any external stimulation of previous infection. This is either possessed from birth or acquired during growth. It may be :—

(i) *Species Immunity e.g.*, hens against tetanus; dogs, rats and mice against tuberculosis.
(ii) *Racial Immunity, e.g.* negroes to yellow fever.
(iii) *Individual Immunity.*

Acquired Immunity :—This may be acquired in two ways *i.e.*, actively and passively.

(a) *Active* :—Anti-bodies are formed due to reaction of persons's own tissues in acquiring resistance. Body cells are actively stimulated to produce antibodies by natural or artificial means *i.e.*, germs of a previous clinical or subclinical infection or as a result of inoculation with germs or their products.

(b) *Passive* :—It is acquired by introduction from without of antibodies induced in some other immune person or an animal.

It may take place in three ways :—

1. A mother supplies immune bodies to her foetus.
2. The inoculation of immune blood or serum from convalescents.
3. The inoculation of serum from animals artificially immunised.

Protective measures produced in the body against infections :—There are three principal means of protection which the body can produce :—

1. *Phagocytosis* :—Which is an action, some of the white blood cells possess of encircling and ingesting invading organisms.

2. Antitoxins are chemical substances produced in the blood serum in the presence of toxins in the body.

3. Antibodies are similar to antitoxins but more specific in their action.

1. Active Acquired Immunity :—This may be :—

(a) *Natural Active Acquired Immunity* :—In some diseases, an attack of infectious disease confers upon a person a certain amount of immunity from a second attack *e.g.*, smallpox.

(b) *Artificial Active Acquired Immunity* :—It is due to inoculation of certain material containing antigen substances derived from bacteria or viruses.

Antigen :—It is a substance which stimulates the body to produce protective materials called antibodies. They are protective entities produced as a result of stimulation of the body by antigenic substances. Antigens commonly used to produce immunity in man are of 3 types, namely :—

1. Living attenuated organisms against smallpox and rabies.
2. Killed organisms against typhoid, cholera, whooping cough etc.
3. Toxins against diphtheria, scarlet fever etc.

2. Passive acquired immunity :—If serum of an animal containing antibodies is injected into a susceptible animal it confers immunity. This immunity is of a short duration and is of particular value in treatment, chiefly for tiding over a crisis when antibodies are lacking in the blood of the patient.

Antisera are of 3 types :—

(*1*) *Antibacterial Serum* :—When bacterial cell body is used it has the power to agglutinate and kill the bacteria *e.g.*, antistreptococcal, antimeningococcal and antiplague serum.

(*2*) *Antitoxic Serum* :—In this type, filtered toxin of bacteria is used. It has power to neutralise toxins of the organisms *e.g.*, anti-diphtheritic and anti-tetanic serum.

(*3*) *Convalescent or Antiviral Sera* :—In virus diseases like measles and poliomyelitis the serum of convalescent cases contains specific antibodies for the virus. They have been used for passive immunisation.

Allergy :—It is a hypersensitivity to some foreign protein introduced into the body by injection or occasionally, in an article of diet. Small amount of this protein will produce a violent reaction on the part of the patient. Asthma, hay fever, migraine and some forms of eczema and urticaria are examples of allergic conditions.

Anaphylaxis :—In a patient with an allergic tendency the giving of a serum will cause an alteration to develop in his tissues within 10 to 14 days, which renders them intolerant of a second dose. This condition is known as anaphylaxis. It may last indefinitely, but it will produce no symptoms unless another dose of the serum is given.

In human beings the symptoms of severe shock may supervene quickly and be followed some days later by rashes, joint pains and oedema. The shock may even terminate fatally but fortunately anaphylaxis is a very rare condition. In order to avoid anaphylactic shock any patient who has previously been given serum is tested for sensitivity before serum is again adminis-

tered. A small dose-usually—2 c. c.—is injected intradermally. If the patient is sensitive, redness and swelling at the site of inoculation will appear within a few minutes and will develop into a wheal in less than an hour. Such a patient must be desensitised by injecting from 5 to 1 c.c. of serum subcutaneously. This is followed either by the whole therapeutic dose from 4 to 6 hours later or by giving divided doses at hourly intervals until the full amount has been injected A hypodermic injection of adrenalin administered at the same time will lessen the danger of anaphylactic shock.

Serum Rashes and Serum Sickness :—Serum rashes some times occur in people with an allergic tendency from 7 to 11 days after the injection has been given. The rash may be just a simple urticaria or it may simulate that of scarlet fever or of measles and all types may be present in the same person. The distribution however, is different from that of a specific infectious fever for it usually commences near the site of inoculation. Serum rashes give rise to great irritation, for which calamine lotion has a soothing effect, but they usually fade within a day or two and there may be no other symptoms. Sometimes the patient has a certain degree of pyrexia accompanied by pains in joints and muscles. This condition in which the rash is only one symptom, is known as serum sickness and it is much more common than anaphylaxis occurring in about 10 percent of those given injections of serum.

Herd Immunity :—By this term is meant immunity of a group of people or a community taken as a whole.

Local Immunity :—This term was formerly employed by *Besredka* to denote the resistance which is offered by tissue cells to the infecting agents.

Diseases for which Artificial Active Immunity is Acquired :—

(*a*) By living attenuated organisms :—

(*i*) *Vaccination against small-pox* :—Artificial active acquired immunity is obtained against the disease by vaccination.

(*ii*) *B. C. G. Vaccination against tuberculosis.*

(*iii*) *Vaccine against yellow fever* :—5 c. c. of living attenuated virus vaccine is given. Immunity develops within 10-14 days and lasts for 2-4 years.

(*iv*) *Vaccine against plague* :—(Vogel and Otten) Prophylactic inoculation is done with avirulent living plague bacilli in Jawa, Madagascar etc. Immunity lasts for six months to a year.

(*b*) By killed organisms :—

(*i*) *Typhoid fever* :—T.A.B. Vaccine.
(*ii*) *Cholera* :—Anticholera Vaccine.
(*iii*) *Plague* :—Haffkin's Vaccine modified by Sokhey.
(*iv*) *Typhus* :—Wright's and Blanc's Vaccine:
(*v*) *Rabies* :—Antirabic Vaccine.

(*c*) By bacterial filtrates or Extracts :—

(*i*) *Diphtheria* :—(*a*) A.P.T. (alum precipitated toxoid)
(*b*) T.A.F. (toxoid antitoxin floccules)
(*c*) T.A.M. (toxoid antitoxin mixture)
(*d*) F.T. (formol toxoid).
(*ii*) *Tetanus* :—T.T. (tetanus toxoid).
(*iii*) *Scarlet fever* :—500 skin test doses increasing to 80,000 or 100,000 skin test doses are given subcutaneously in course of five injections subcutaneously. Immunity develops within two weeks and lasts from 1-5 years.

Diseases in which Artificial Passive Immunity is Acquired :—

(*i*) *By Convalescent Serum* :—In measles, convalescent serum and gammaglobulins give good results. It has also been tried in poliomyelitis.
(*ii*) *By antitoxic-Serum* :—In tetanus, scarlet fever, diphtheria.
(*iii*) *By Antibacterial Serum* :—It is not of any prophylactic value.

The chart regarding the recommended schedule of routine immunisation and vaccination from infancy to adult life (adopted from the diary published by Medical College Amritsar for the year 1961), is given on the next pages.

Notification :—By this term is meant immediate intimation regarding occurrence of every case of an infectious disease to the health authority of that locality. It may be the municipal medical officer of health or district medical officer of health.

Advantages of Prompt Notification :—

1. It enables the authorities to isolate the patient to treat him and to do necessary disinfection.
2. It helps to prevent the spread of infection by promptly taking measures and thus safeguard the rest of the community by inoculation *e.g.*, vaccination for smallpox. T.A.B. and anticholera inoculations are administered to the public on the outbreak of enteric fever and cholera infections respectively.
3. The real and original source of infection can be found out. The distribution of the case or cases in the

Recomended Schedule of Routine Immunization

Item	Age	Immunizing Agent	Route of Administration
1.	At birth or within 10 days of birth & even upto first month of life.	B. C. G.	Multiple Punctures or I/D.
2.	3rd month, 4th month, 5th month } Primary immunization.	D.P.T. (Diphtheria Pertuses & Tetanus) (triple Antigen.)	I/M
3.	6 months.	Vaccinia Virus	Multiple Punctures or Multiple pressures.
4.	7th month, 8th month, 15th month } Primary immunization Booster.	Polio Vaccine	I/M
5.	18th month 36th month 60th month	D.P.T., D.P.T., D.P.T. } Booster doses	I/M
6.	After injury (tetanus) or exposure to diphtheria or whooping cough in previously immunized child.	D.P.T. or individual Antigen.	I/M

& Vaccination from Infancy to Adult Life

Dose	Protective Period	Contraindication
As per direction on the vial or tube.	4-5 years	
As per direction by the manufacturers.	About 3 years.	(i) Pertusis Vaccine may not be given to children with positive family history of epilepsy or with convulsions on slight rise of temperature to prevent post-vaccinal encephalitis. (ii) Triple Antigen should be postponed during an epidemic of Polio.
One drop.	3 years (Internationally accepted) In general practice every 4-5 years.	Septic skin conditions like boils scabies, eczema, erysipelas, Diarrhoea, Dysentery, Fever, Severe Anaemia, 1st 3 months of pregnancy and in any family where other children are suffering from skin infections.
As per direction by the manufacturer.	4-5 years (Salk work)	Do not perform operations in the oral cavity (tooth extraction, removal of tonsil etc.) during an epidemic of polio.
As per direction by the manufacturer.	About 3 years.	As described previously.
As per direction by the manufacturer.	About 3 years.	

Recomended Schedule of Routine Immunization

Item	Age	Immunizing Agent	Route of Administration
7.	After exposure tour during epidemic of small/pox. *N.B.* Small pox Vaccination should be performed every three years.	Vaccinia virus.	Multiple Punctures or Multiple pressures.
8.	By 5 years of age or so. 2-3 doses at interval of 10-14 days.	T.A.B. (Typhoid, Para A & Para-B.)	Subcutaneous or I/M
	Every year (as per old concept) or every 3 years as per recent work.	T.A.B.	I/D or subcutaneous
9.	5 years 10 years 15 years 20 years	B.C.G. Booster doses,	Multiple punctures or I/D

N. B. 1. (a) According to recent trend and as per recommendation of the American Public Health Association, New York, Polio Vaccine can be combined with D.P.T. and this procedure saves time, money and inconvenience.

(b) Oral Polio Vaccine has been tried successfully on millions of the children by now and may replace Salk vaccine.

2. Plague, Cholera and Influenza Vaccines are given whenever there is actual danger of these diseases. As a normal routine they are not given.

& Vaccination from Infancy to Adult Life—*concld.*

Dose	Protective period	Contraindication
One drop.	3 years.	As previously described.
0.2 c.c., 0.4 c.c. 0·4 c.c.,	1 year (as per previous concept), but latest work indicates that immunity may last for 3 years or so.	
I/D 0 1 c.c. to 0.2 c.c. S/C. or I/M 0.5 c.c.	As previously indicated.	As per certain authorities do not give T.A.B. during the later part of incubation period of typhoid because of the possibility of danger duringnegative phase.
	4-5 years.	Do not give it to people who are tuberculin positive. Before giving B.C.G. as Booster dose always do tuberculin test.

3. Recently mumps vaccine has been tried with reasonable degree of success.

4. Yellow fever inoculation is only given to those International passengers who are proceeding to certain areas in Africa and South America.

5. Normal Gamma Globulins have the value of producing modified measles (when given between 4th & 6th day of the incubation period) and modifying or suppressing attack of infectious hapatitis.

district or the town is known.

4. It enables to control the spread of infection through schools or other centres by excluding members of infected households.
5. It provides opportunity of investigating the source of any epidemic disease by examining milksupplies, watersupplies and other common focii.
6. It gives opportunity of investigation of the sanitary condition of all households, where case of enteric fever or diphtheria or other notifiable diseases may occur.
7. The first case to come to the attention of the local health authority may not be the first case to have occurred. Old missed cases will be discovered which may be as potentially dangerous and infectious as reported cases.
8. It will give opportunity to watch for suspicious and potential cases. Some members of the family may be slightly ill, or be incubating the disease ; so be in a look out for additional evidence of the disease.

Notifiable Diseases :—

They are as follows :—Cholera, smallpox, chickenpox, plague, enteric fever, dysentery, diphtheria, mumps, tuberculosis, scarletfever, leprosy, influenza, whooping cough, cerebro-spinal fever, puerperal fever, erysipelas, sprue, measles, yellow fever, relapsing fever, typhus etc.

Who should notify :—

1. A medical practitioner, who examines a case and diagnoses it to be a case of infectious disease. It is better to notify even if it is a doubtful one. For this omission, action under Municipal Act can be taken against him.
2. Any guardian or a relation of a case who is attending on him.
3. Any person living in the same house.
4. Manager of a hotel or an institution where a case of an infectious disease occurs.

Isolation :—It is the separation, for the period of communicability of infected person, from other persons in such places and under such conditions as will prevent the direct or indirect conveyance of an infectious agent from infected persons to other persons who are susceptible or who may spread the agent to others. It is the most perfect single method to check the spread

of infectious diseases. The period of isolation should usually be the period, till, he is not infective to others. An infective case may be isolated in two ways :—

(*i*) In an infectious diseases or isolation hospital.
(*ii*) At home, called house isolation.

Isolation Hospital :—In all towns, it is necessary to provide hospital accommodation for the isolation and treatment of cases of infectious diseases. In England, the standard aimed at, is provision of one bed for 1000 of the inhabitants. The essential features of an isolation hospital are that the site should be dry, healthy and welldrained. It should be away from the congested area but should have a convenient approach. Separate wards should be provided for different infectious diseases. Each patient should have 144 sq. feet floor space and 6000 cubic feet of fresh air per hour. There should be a proper arrangement for the supply of pure water, removal of excreta and urine, and disinfection of soiled clothes in which provision of a steam disinfector is essential. It must be provided with an ambulance car for removal of infectious disease cases to the hospital. If that is not possible, a rubberwheeled stretcher or even a countrycart be provided, which can be disinfected after bringing the patient to the hospital. There should be capacious open land in the hospital compound or just adjacent to the hospital where temporary huts or wards can be constructed or tents be pitched at the time of the outbreak of an epidemic.

Barrier Nursing :—This is suitable for the nursing of all conditions where direct or indirect contact is necessary for the transmission of the infection. There may be a screen which marks the "barrier" between one patient and another, but a visible line of demarcation is not necessary. A gown hangs by the bedside to don before touching the patient, his bed or his belongings. Each patient has his own thermometer, feeding utensils and washing and toilet requisites. Even the temperature chart has its own pencil attached. After any attention to the patient the nurse removes her gown, thoroughly scrubs her hands and nails, rinsing them in a disinfectant solution such as Dettol where this appears necessary.

Cubicle Nursing :—Partitions separate the beds from each other and from the centre of the ward. They are usually about 7 feet in height and are made almost entirely of glass, which makes for a good light and allows for observation of the patient at all times. These cubicles have a common airspace only above the partition, prevent droplet or air borne infection from one patient to another. When the partition extends to the ceiling so that the patient is quite shut off from others, the system is known as "*chamber nursing*". Each cubicle or chamber should

contain a wash basin and have a swing door. The nursing technique is the same as in bed isolation.

Bed Isolation :—This is very similar to barrier nursing except that feeding and toilet requisites are not kept separately for each patient, but are sterilised immediately after use and are then kept with other general equipment of the Ward.

House Isolation or Home or Private Isolation :—It is done in patients own private houses. The following points should be observed:—1. The sick room should be detached, preferably, in the upper storey.

2. All unnecessary furniture should be removed.

3. A sheet soaked in a disinfectant such as 1 in 20 solution of carbolic acid should be hung up in front of the door as a curtain. It will help in arresting contagion in the case of air-borne diseases and it will act more effectively as a danger signal to warn off the visitors.

4. The windows should be kept open as much as possible to ensure ventilation.

5. Only attendants or nurses should be allowed to go in the sick room. They must wash their hands in some disinfectant solution before leaving the sick room. The outer dress of the attendants should be easily washable and should be changed on going out of the room.

6. The attendants should be selected from among the persons who have had the disease or have acquired immunity by prophylactic inoculation against the disease.

7. The soiled clothes of the patient should be immersed in a disinfectant solution and afterwards boiled, to disinfect them.

8. Excreta and remnants of food should be received in a vessel containing a strong disinfectant solution and should be buried in the ground and burnt away.

9. Antifly and antimosquito measures must be taken to exclude flies and mosquitoes from the sick room.

10. The utensils must be disinfected properly after leaving the sick room.

11. Fire should be kept burning in the sick room or in its verandah for destroying the waste materials contaminated with discharges. etc., of the patient.

12. Visitors should not be allowed to enter the sick room but if necessary should speak to the sick through the curtain at the door or through the windows.

13. Children, clerks or workers from the infected house should not be allowed to go to their respective institutions.

14. When the danger of infection is believed to have ceased, the patient should be wellwashed and bathed thoroughly with soap and water and given a complete change of clothes, before he is allowed to mix up with other persons.

15. In case of death, the dead body should be completely covered in a sheet soaked in corrosive sublimate or carbolic lotion. Subsequently, it should be buried or cremated as soon as possible.

16. The sick room should be thoroughly disinfected after having been vacated by the patient.

It is necessary to remark that unless the patient and the family give the most willing mutual assistance, it is very difficult to carry out these measures in private houses and even in hospitals. Sanitary officials and medical men should therefore endeavour to induce the patients and their friends to consent to the removal of cases of infectious diseases to an isolation hospital if there is one, where they can be better cared for, and be less dangerous to their family members and other neighbours. It must be borne in mind that even imperfect and incomplete isolation is better than none and may aid a good deal in checking the spread of communicable diseases.

DISINFECTION

By this term is meant the process of application of a disinfectant for a sufficient length of time and in adequate quantity and strength so as to kill the specific organisms of infectious diseases.

Concurrent disinfection :—Is the application of disinfection immediately after the discharge of infectious materials from the body of an infected person, and the immediate application of disinfection to articles soiled with infectious material.

Terminal Disinfection :—Is the process of rendering the personal clothing and immediate physical environment of the patient free from the possibility of conveying infection to others after the patient has ceased to be a source of infection.

Sterilization :—Is the destruction of all microbial life *i.e.*, microorganisms and their spares by physical and chemical means.

Fumigation:—Is the process by which the destruction of insects and animals is accomplished by the employment of gaseous or volatile agents. It is very useful in preventing the spread of insectborne diseases.

Disinfestation:—Means any process by which insects and animals capable of transmitting infection may be destroyed.

Delousing :—Is the process of killing lice and their eggs on persons or in their apparel.

Disinfectant :—It is a substance which destroys pathogenic microbes, virus, fungi or protozoa.

Germicide :—It is a substance or an agent which destroys germs. Disinfectant and germicide are interchangeable terms.

Bacteriostatic :—It is a substance which inhibits the growth of microorganisms.

Antiseptic :—It is a substance which prevents decomposition and retards or prevents the growth and activity of microorganisms but does not necessarily destroy them or it delays or prevents decomposition and fermentation without destroying the microorganisms causing the process, *e.g.*, sugar in jams and salt in fish, etc. Some disinfectants in weaker solution act as antiseptics *i.e.*, bichloride of mercury and formalin in the ratio of 1 in 30,000 and 1 in 5.000 respectively.

Asepsis :—A state of asepsis is said to exist when an article is absolutely free from pathogenic microorganisms and their spores. Such an article is said to be sterile.

Deodorant :—It is a substance having the power to destroy or to neutralise the unpleasant odour of the organic matter undergoing fermentation or putrefaction, *e.g.*, charcoal. Some deodorants destroy offensive odours simply by substituting an agreeable or a strong smell without destroying the organisms giving rise to putrefactive odours. Volatile oils having pungent odours are not deodorants. They simply cover one smell over the other. Formalin is both disinfectant and a deodorant.

Classification of Disinfectants :—They are divided into three groups :—(I) Natural:—Fresh air and sunlight.

(II) Physical:—

(*a*) Dry Heat:—1. Burning by Fire. 2. Hot Dry Air.
(*b*) Moist Heat:—1. Boiling. 2. Steam.

(III) Chemicals:—(*a*) Solids.
(*b*) Liquids.
(*c*) Gases.
(*d*) Aerosols

(I) Natural Disinfectants :—Fresh air and sunlight destroy infection and limit the spread of infectious diseases. By drying, the microorganisms are attenuated and their multiplication is inhibited. Oxygen of the air plays an important part in killing micro-organisms.

Sunlight is a strong germicide due to the actinic rays, especially ultraviolet rays. The action of the actinic rays on the atmosphere is such that they form ozone and hydrogen peroxide

which are powerful oxidising agents. The yellow and the red rays of the sun however possess no disinfecting power.

(II) Physical Disinfectants :—(a) **Dry Heat** :—*1. Burning* :—This is the best means of disinfection. It should be employed for articles of small value. Burning is done in a small destructor furnace and should not be done in open air. Cheap infected dwellings or huts may be burnt away. Cholera and enteric infected excreta should be burnt by mixing them with sawdust and kerosene oil. Sputum and other discharges are best destroyed by burning.

2. Hot Dry Air :—It has a very little or no penetrating power and to destroy spores; high temperature has to be maintained for a long time at a stretch, which ruins nearly all fabrics. So it is not employed for this reason. It is, however, useful for the disinfection of leather goods, books, furs, Indiarubber, etc., which are spoiled by the action of water or steam.

(b) Moist Heat :—*1. Boiling* :—This is a very efficient method. Boiling for 10 minutes is sufficient for killing ordinary germs, but for spores boiling should be continued for at least half an hour. Clothes stained with blood or faeces should be first washed with soap and then boiled, otherwise a permanent stain will remain behind. Boiling is not suited for disinfecting woollen material as it shrinks. Linen handkerchiefs, bedsheets, bed pans, urinals, cooking utensils, etc., are disinfected by this method. This process cannot be depended upon in hills or at high altitudes. The boiling point falls at an average rate of 1°C for every 1000 feet ascent. This process is expensive on a large scale but is commonly used on a small scale.

2. *Steam* :—It is used in three ways :—(*a*) Current Steam. (*b*) Saturated Steam. (*c*) Superheated Steam.

(*a*) *Current Steam* :—When steam is generated at ordinary atmospheric pressure of 376 at a temperature of 100°C and is allowed to escape, it is called Current Steam. This is also called Low Pressure Steam. It has got the same disinfecting power as boiling water.

Current steam disinfector is cheap at the outset but expensive in the long run because it consumes more fuel.

(*b*) *Saturated Steam* :—When steam is generated by boiling water in a closed vessel *e.g.* in a steam boiler or a kettle, steam issues and accumulates under pressure and longer the period for which water is boiled the greater will be the pressure. The steam so generated is called saturated steam. It is not only compressed in small volume but is also at a higher temperature. There is always a definite relationship between the pressure of the steam and its temperature, *e.g.* steam at 20 lbs. pressure, is at

120°C. Steam upto 5 lbs. pressure is low pressure steam and when pressure is increased to 10 lbs. then it is called high pressure steam.

When current steam or saturated steam comes into contact with cooler articles, it immediately gets condensed and in doing so, parts with its latent heat and shrinks to 1/1600th part of its volume. Thus a partial vacuum is created which is at once filled by more steam from behind and so on. It thus raises the temperature in the vicinity to a high degree. This process of condensing will continue until the temperature of whole of the bundle of the articles to be disinfected is raised to that of the steam. When the disinfection is complete, no further condensation of steam occurs. Saturated steam is better than superheated steam because it is near to its condensation point and has got more rapid power of penetration.

(*c*) *Superheated Steam* :—It can be generated in two ways :—

1. If steam is heated, without raising the pressure, the temperature of steam is highly raised, it is called Superheated Steam.

2. It may also be generated by boiling saline solution which boils at a higher temperature than ordinary water.

It has got properties similar to those of dry gas and has no value as a disinfectant as it has lost its physical character as vapour. It cannot condense until it has parted with its super heat.

Before using a physical disinfectant, its effects on colour and texture of the articles to be disinfected must be considered. Woollen goods as well as those composed of cotton and linen will not stand high temperature. Most fabrics will stand a temperature of 110°C without undergoing any permanent injury. Cotton and linen will bear 110°C dry heat for hours but 112°C moist heat only for half an hour. Cotton is scorched at a temperature of 150°C. Scorching occurs comparatively sooner with woollen material. 126°C moist heat applied for 30 minutes turns white woollen blankets yellow and diminishes the tensile strength of hair and causes shrinkage.

Steam Disinfecting Station :—It should fulfil the following requirements :—It should be easily accessible. It should have a van of its own for bringing infected articles for disinfection. Separate sheds should be provided for vans to bring infected articles and for those to return the disinfected articles. The infected articles can be transported in long canvas bags having distinguishing numbers, woven into them or permanently stamped on them. The advantage of putting articles in bags with numbers on them is that the owner on disinfected side can pre-

sent his token and receive the articles after disinfection. Infected articles should be put in bags, which are stitched and taken to the disinfecting station in a properly closed unlined van. The whole bag is put in the disinfector without opening.

Building :—The building should be constructed on improved sanitary principles. The floor should be of marbleslabs, tiles or polishedcement; walls should have tiled dadow, *i.e* 4½ feet of white tiles from the floor and rest of the wall should be distempered with a white water-proof paint. All angles should be rounded and no projections permitted for accumulation of dust. Window space should be ample to provide full light and admit free ventilation.

The actual building is constructed in two halves which in no way should directly communicate with each other except through the disinfectingmachine. One half is the infected side, meant for receiving infected clothes, articles etc. Into this side, opens one end of the disinfector. The workers on this end should wear overalls and the infected clothings, beddings etc., should be run into the disinfector over a trolly or a sliding cage. The door of the disinfector is closed and steam let in. When the disinfection is complete, the disinfector is opened from the other half of the shed and the disinfected clothes, bedding, etc. are taken out and returned to their owners. A different van, with a separate garage should be used for this purpose.

There should be some arrangement for ascertaining the efficiency of the disinfector. A raw egg is placed in the centre of the bundle of clothes, and this is seen after the disinfection. If it is completely boiled, it indicates that thorough disinfection has taken place. If it is not completely boiled, it indicates that the steam has not reached the centre of the bundle of clothes. It can also be tested by placing a culture of suitable micro-organisms and finding out whether they have been killed, by recording thermometers or the use of a metal couple which makes contact and indicates that a certain temperature has been reached.

Different Varieties of Disinfectors :—

1. *Washington Lyon's (Manlove and Alliott) High Pressure Disinfector* :—In this type saturated steam underpressure is used with a temperature of 115°C to 120°C. It is an elongated cylinder, oval in section, with a door at each end. The disinfecting-chamber is surrounded by a jacket and the steam is obtained by a separate boiler, the pressure at which it works is 15 to 20 lbs. per square inch. There is an arrangement of producing a vacuum by aspirating air out of the chamber. In working it, steam is first admitted into the jacket to heat the chamber inside so that the steam may not be quickly condensed. Then a

vacuum is produced for about 20 minutes. Subsequently the steam is admitted inside the chamber for about 20 minutes after which vacuum is again made. A current of hot air is passed in

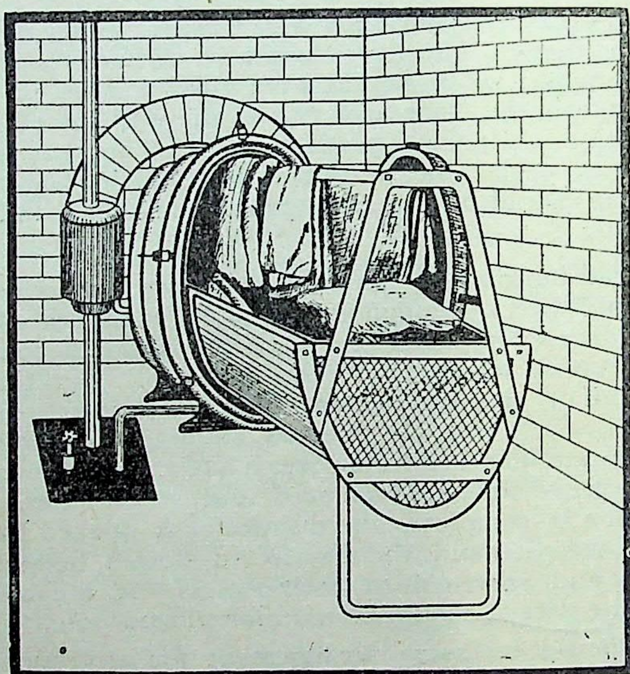


Fig. 45—Steam Disinfector with Cradle

the disinfector to dry the clothes. The disinfecting chamber is sufficiently large to admit beddings etc., and is built in the partition wall between two rooms.

2. *Thresh's Current Steam Disinfector* :—It is a lowpressure disinfector and does not require the installation of a separate boiler. It consists of a chamber surrounded by a jacket. In this jacket steam is generated from a saline solution usually calcium chloride, which raises the boiling point of water above 100°C without any extra pressure. The boiler is fed with water from a cistern. The time required for exposure of the infected articles is usually 30 minutes. The apparatus is simple, cheap and is best suited for use in small hospitals and municipalities. Although it is a low pressure mechanism yet the steam is very hot as it is given off from water over 100°C.

3. *Lelean's Sack Disinfector* :—It is a currentsteamdisinfector. It is light, simple and comparatively a cheap apparatus. It consists of a long sack made of some material impervious to steam such as canvas, a boiler, a hose pipe and a stove. The

sack is suspended like a bell, the open lower end has a purse string mouth, and the closed end is upward. The infected-clothings are suspended by means of hooks. Steam is admitted at the top through the hose pipe as long as necessary, which is generated in a small boiler heated with a stove. Exposure for 30-60 minutes is sufficient for disinfection. It is easily portable and can be carried on a bicycle; and is used in some municipalities.

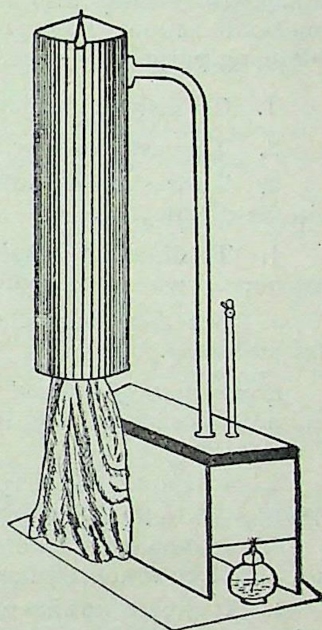


Fig. 46
Lelean's Sack Disinfector

4. *Serbian Barrel*:—It was first introduced in Serbia and Bulgaria during the typhus campaign and is the best method of steam disinfection and disinfestation of lice from clothes. It consists of a barrel with perforated bottom which rests on a sandbag collar to prevent the escape of steam which enters the barrel through the perforated holes from a metal tank containing water, upon which it rests. The top of the barrel is covered with a removable lid with hooks to hang infected articles, clothes etc. The barrel with the boiler is placed on brick work frame forming the furnace. After about an hour's exposure to steam, the articles will be satisfactorily disinfected and disinfested. It is a type of disinfector in which current steam is used.

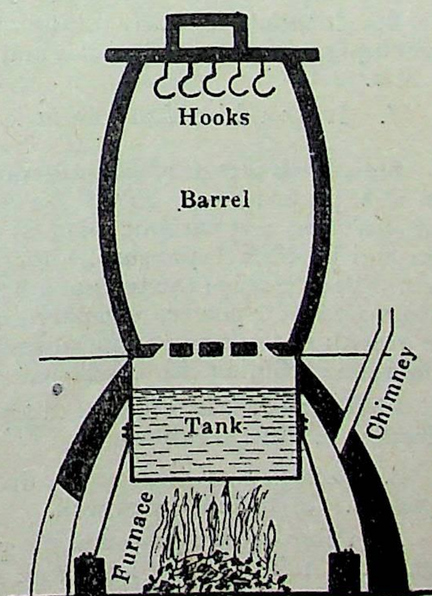


Fig. 47—Serbian Barrel Disinfector

(III) Chemical Disinfectants:—The manner in which the chemical disinfectants act is not fully understood as yet. They chiefly act by oxidising and coagulating the protoplasm

of bacteria. They also act by ionic coagulation, desiccation, emulsoid action, absorption etc. They are used for the following purposes :—

1. To disinfect or deodorise faeces, urine, sputum etc.

2. To wash the floor and walls.

3. To wash iron and wooden articles, which cannot otherwise be disinfected.

4. To disinfect hands in surgical operations and cutting instruments which are spoiled by boiling:

5. Gaseous disinfectants are used for disinfecting houses and buildings.

Requirements of a Good Disinfectant :—1. It should be homogenious and should have definite efficiency for a particular type of organism.

2. It should be a powerful germicide, rapid in action, having a great power of penetration.

3. It should be stable in presence of organic matter. It should not be rendered inert in the presence of faeces.

4. It should not have any injurious effect on human tissues and material submitted for disinfection.

5. It should preferably be soluble in water and should form a uniform emulsion in all proportions.

6. It should be fairly cheap and should not act on metals, bleach pigments or spoil fabrics and should be neither toxic nor caustic.

7. It should be high solvent for grease.

Standardisation of Disinfectants :—Two methods are used for this purpose:—1. *Rilial Walker or Carbolic Acid Co-efficient test:*—In this test carbolic acid is used as a standard disinfectant and Bacillus typhosus 24 hours' culture, as the test organisms. The result of the tests of other disinfectants are expressed in terms of their power, compared to the standard of inhibiting the growth of the same organisms within the same time. This is called the carbolic acid co-efficient of a particular disinfectant.

Method :—1. Take several tubes containing 5 c.c. of the disinfectant in different dilutions.

2. To each test tube add 5 drops of the culture of bacillus typhosus. Shake the tubes well.

3. After every 2½ minutes, prepare sub-cultures from these inoculated tubes into 5 c.c. broth for 15 minutes, *e.g.* 2½, 5, 7½, 10, 12½ and 15 minutes *i.e.*, in all 6 series of sub-cultures are made.

4. For 48 hours incubate all sub-cultures at 37°C and note the presence or absence of the growth.

5. Carry out the same process within the same time, with same culture, with dilutions of carbolic acid.

6. See from the table of results, the two dilutions having the same effect in the same time and therefrom calculate the carbolic acid coefficient of the disinfectant.

The British Admirality Method for Standardisation of Disinfectant :—It is the best method and is done as follows :—

1. 10 c.c. of the disinfectant is diluted to 1000 c.c. with sterile, artificial sea water (32 gms. of Tidman's sea salt dissolved in 1 litre of water) and allowed to stand for 24 hours. A portion of this mixture is removed from the middle with a pipette for test purposes. The standard is crystallised phenol, also dissolved in artificial sea water and the test organism is bacillus typhosus 24 hours' culture in nutrient broth at 37°C.

2. Organisms remain in contact with the disinfectant for 10 minutes, the temperature of the broth and the room being 10°C and 18°C respectively.

3. The germicidal value of the disinfectant is determined in the presence of a definite amount of organic matter consisting of gelatine and finely ground rice starch (0.5% of gelatine and 0.5% of rice starch in suspension in sterile water).

4. 0.25 c.c. of the culture is added in 5 c.c. of the above solution and 5 c.c. of the disinfectant and the mixture shaken thoroughly. After 10 minutes, a sub-culture is made in broth and is incubated for 48 hours at 37°C and the presence or absence of the growth is noted.

The following chemicals are generally used as disinfectants :—

1. *Perchloride of mercury or Bichloride of mercury or Corrosive Sublimate* :—It is a very valuable and powerful disinfectant against germs and spores but it is not a deoderant. It is used as 1 in 1,000 dilution, which kills glanders, diphtheria, anthrax and typhoid germs in 10 minutes. It destroys spores, after an exposure of one hour, in 1 in 500 strength.

This salt has the following disadvantages :—1. The solution is extremely poisonous and quite colourless, hence there is a reason for adding aniline blue in the standard formula, to impart colour.

2. The solution corrodes metals, therefore it cannot be used for metallic vessels.

3. All mercuric salts are precipitated by albuminous compounds such as faeces and sputum. This has been overcome in the standard formula by the addition of hydrochloric acid. This

solution can be used for disinfecting faeces, urine, sputum, etc., provided they are not kept in metallic vessels.

The formula generally used is :—

Hydrargyri Perchloride	...	½ oz.
Hydrochloric Acid	...	1 oz.
Commercial Aniline	...	3 grs.
Water	...	3 gallons.

Tablets of Hydrargyri Perchlor are also procurable, which are very convenient to use.

2. *Mercuric iodide* :—It is less poisonous but is as good in action as mercuric chloride. It does not precipitate albumin. It is not soluble in water but is soluble in the presence of potassium iodide and in alcohol. It attacks metals. A solution of 1 in 1000 is ordinarily used.

3. *Coal-tar Disinfectants* :—The following preparations are used :— (*a*) *Carbolic acid or phenol* :—It is a cheap and useful disinfectant. It has a wide range of applications but should not be depended upon to kill spores. Crude carbolic acid dissolves in water with some difficulty therefore, it should be thoroughly dissolved before use. It is used in solution of 3.5 to 5% and when used in this strength it will kill ordinary sporeless bacilli within a few minutes to ten hours. It is used for mopping floors, walls and ceilings. Carbolic acid is non-corrosive to metals, so it is used for disinfecting knives, etc. It does not harm fabrics or affects their colour nor it coagulates albumen. It is poisonous and caustic

(*b*) *Coal-tar Derivatives* :—They are obtained by the destructive distillation of coal and contain phenol, neutral oil, resin, fatty oils and water. They are izal, cyllin, sanitas, lysol, jay's fluid, phenyl etc. They are allied to carbolic acid but are not so poisonous and are used in strength of 1 to 3% in the form of emulsion. Their activity depends upon the fineness of emulsion and are very efficient like carbolic acid.

4. *Potassium permanganate* :—Its disinfecting powers are due to oxidation. It is used for disinfection of water in the outbreaks of cholera. It is generally used as a disinfectant in 5% solution but in less than half per cent solution it acts only as a deodorant. For disinfection of a well, dissolve the required quantity, say 6 ozs. of potassium permanganate in a bucket of water till every crystal is dissolved. Add it to the well and shake the well water. Draw out a bucket of water and note the colour of the water. If it is not pink, add more potassium permanganate. Leave the well water undisturbed for 8 hours. The disinfection of the wells is generally done in the evening and water

is drawn out in the morning. It is expensive and soon becomes inert by organic matter. It stains everything it comes into contact with. The stain produced by it can be removed by treating it with a solution of oxalic acid or simple lemon juice.

5. *Lime* is one of the cheapest and powerful disinfectants. Freshly burnt or quick-lime should be used. It is used to disinfect stools, floors, stables, etc. One per cent solution of lime kills organisms other than spores in a few hours. For stools equal quantity should be used and thoroughly mixed with a stick and allowed to stand for two hours.

6. *Chloride of lime or bleaching powder* :—It is unstable and deteriorates on keeping. It should be kept in airtight containers. A good sample of bleaching powder should contain about 33% of available chlorine. It is a mixture of calcium chloride and calcium hypochlorite. Owing to its affinity for moisture, which it slowly absorbs from the air, it soon becomes pasty and loses some of its chlorine. Hypochlorites present in the lime are then reduced to chlorides and thus it becomes inert. Freshly prepared chlorinated lime should have a very light odour of free chlorine. A strong odour of the gas indicates its deterioration. Chlorinated lime not only bleaches, but is also destructive to fabrics. It may be used as a dry powder or may be dissolved and used in the form of a solution as a surface disinfectant. As a dry powder it is sprinkled over damp corners of cellars, privies, latrines, drains, etc. where it acts as a deodorant and desiccant. It is also used in a powder form to disinfect excreta.

5% solution of bleaching powder can be used for disinfecting stools. It is mixed with a stick and allowed to act for 1 to 2 hours. I in 30 solution of bleaching powder is used for disinfecting rooms.

In recent years chlorinated lime has come into special prominence for disinfecting drinking water. For disinfecting wells, about ½ oz. of active bleaching powder will be required for 1000 gallons of water. The following is a good working formula for disinfecting water supplies of wells :—

$$X = 15.7 \times R^2 D$$

X = Grains of bleaching powder required.
R = Radius of well in feet.
D = Depth of well in feet.

For Tanks :—A waterarea of about an acre with an average depth of 5 feet will require 10—12 lbs. of bleaching powder. The powder should be tied in bundles, dusters or gunny bags and then dragged in water especially near the edges after fixing them to a rope or bamboo and then the tank is left unused for 6 hours.

For Disinfecting Water for Domestic Purposes :—Prepare a stock solution by taking one teaspoonful or one drachm of bleaching powder and dissolve in a pint of water. 5 drops of this stock solution are added to a pint or 20 ozs. of water and allowed to stand for 30 minutes. This method is adopted when people visit places where cases of cholera, typhoid and dysentery are occurring.

(1) *Effective Chlorination Tests* :—Sample of water is taken half an hour after treatment and one or two crystals of potassium iodide are dissolved and then a few drops of freshly prepared starch solution are added. If a faint bluish green colour develops, it indicates that the chlorination has been effective.

(2) *Orthotolidine Test* :—2—3 drops of Orthotolidine are added to the sample of water in a test tube. The appearance of yellow colour indicates effective chlorination. Red colour indicates super-chlorination, whereas absence of colour indicates inadequate chlorination.

Gaseous Disinfectants :—A germicidal gas is an ideal weapon to destroy pathogenic micro-organisms, which are to be dealt with in public health work, especially at the terminal disinfection by reaching all portions of the house. A gas lessens the risk of any surface getting neglected on which micro-organisms are lodged. The secret of doing successful disinfection with a gas is to obtain a large voluma of gas in a short time. Presence of a certain amount of heat and moisture is necessary for carrying out disinfection effectively. The exact amount of moisture which is necessary depends upon the temperature. As a general working rule it may be stated that if the prevailing temperature is below 65°F or if relative humidity is below 60% the results become irregular and unreliable, especially if the place is both cold and dry. In cold weather, it may be necessary to artificially warm the room and in dry weather moisture is to be added to the room.

All the openings of the room should be completely closed and all cracks pasted over with paper so as to make the room as air tight as possible. The cubic space of the room is calculated, so as to ascertain the amount of the chemical to be used.

1. *Formaldehyde gas* :—It is a powerful disinfectant. It neither tarnishes metal nor bleaches colour. It does not injure textiles even. It is very irritating to eyes and lungs in stronger dilutions. Its smell can easily be removed by sprinkling ammonia in the room. The temperature of the room should be between 60°F to 65°F (never less than that). In cold weather, if the room is not warmed and disinfection is performed, its effect will be nullified owing to low temperature.

Therefore in this type of disinfection, the room must be kept fairly warm. Formaldehyde gas is a weak insecticide so it is useless as an anti-plague measure. It has lower density than sulphur dioxide and chlorine gas and so it diffuses better and has got greater power of penetration. Formalin vapours are particularly useful for disinfecting blankets, silks, furs, books, leather goods, toys etc., which will not stand steam disinfection.

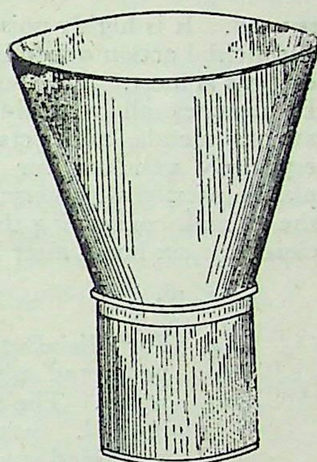


Fig. 48—Bucket for generating formaldehyde

It may be used in the following ways :—

(*a*) *Permanganate method* :—Special tin buckets or jars are used. For disinfecting 1000 cubic ft. of space, 5 ozs. of potassium permanganate is placed in the jar and then on the top of it 10 to 15 ozs. of 40% formalin diluted with an equal volume of water, is poured. There will be violent effervescence and the formaldehyde gas will be set free in a few minutes. Naked fire should be avoided as it might give rise to explosion owing to inflammable character of the gas. This method is simple and effective and the period of disinfection should be about 6 hours.

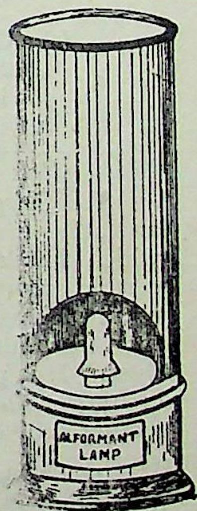


Fig. 49—Paraform Lamp

(*b*) *Bleaching powder method* :—For disinfecting 1000 cubic feet of space 2 lbs. of bleaching powder and 40 ozs. of formalin are required. The bleaching powder is first made into paste with water, and formalin is poured into it.

(*c*) *Paraform method* :—For disinfecting 1000 cubic feet of space 25 paraform tablets of one gramme each are heated in a special paraform lamp. By heating formalin the aldehyde changes into solid polymeroid para-form.

(*d*) *By Trillat's apparatus* :—For disinfecting 1000 cubic feet space ½ to 1 litre of formochloral is used in this apparatus.

2. *Sulphur dioxide* :—It is comparatively less effective than formaldehyde gas. Except for tuberculous sputum, the results with sulphur-dioxide are as good as those when formaldehyde

is used. It is highly poisonous to mammalians and insects. Its germicidal action depends upon the presence of moisture, as the dry gas is inert. The moisture changes it into sulphurous acid. It bleaches all vegetable colours as well as aniline dyes. It attacks metals and acts on cotton and linen fabrics. It is especially valuable for disinfecting ships; cars, stables and places infested with vermin. It not only attacks germs but also the animals concerning their spread. The room should be kept closed for six hours after liberation of the gas.

Methods :—

(*a*) For disinfecting 1000 cubic feet space 2—3 lbs. of powdered sulphur is put in a pot placed in a tub of water. The sulphur is moistened with alcohol and ignited. Sulphur candles may be used in place of powdered sulphur.

(*b*) The same amount of sulphur powder be sprinkled over ignited charcoal. The walls and floors should be sprinkled with water.

(*c*) Clayton's apparatus :—In it, sulphur dioxide and Sulphur trioxide are generated. Sulphur is burnt in an iron generator. This gas has great penetrating power. It is chiefly used for the destruction of vermin, particularly rats, bugs, lice, etc.

3. *Chlorine gas* :—It is a disinfectant and deodoriser as it has an affinity for hydrogen, when it liberates nascent oxygen which has a great affinity for organic matter and bacteria. A certain amount of moisture is also required for disinfecting the room successfully with chlorine gas. It is more irritant to eyes than sulphur dioxide and bleaches all vegetable and aniline dyes. It is produced by the action of one lb. of sulphuric acid or hydrochloric acid on two lbs. of bleaching powder for disinfecting 1000 cubic feet of space.

4. *Cresol fumigation* :—For 1000 cubic feet of space about 6 ozs. of cresol is poured over smouldering cowdung cakes about 20 in number placed in a big iron pan in the centre of the room. This method was used freely for disinfecting plague stricken houses in Punjab and proved to be of great value in killing rat fleas. In buildings having high roofs it is better to fix up a cloth across the room about 10—12 feet from the floor in order to prevent dense fumes of cresol diffusing higher up. The object being to allow the dense fumes produced to act mainly on the floor. The fumes are absolutely safe for all articles, furniture etc. It neither tarnishes metal nor bleaches fabrics. It is non-irritating to eyes, easily produced and is in-

expensive. It is always preferable to use more than one pan in a big room.

5. *Hydrocyanic acid gas* :—This gas has no action on bacteria. It is largely used to destroy rats, fleas, and other vermin, on board the ships, and pumped into rat holes in combating plague epidemic. It is highly penetrative, is chemically inactive and has no bleaching or tarnishing properties. It has practically replaced sulphur dioxide as a fumigant in the United States of America. The gas is highly poisonous and should not be used to disinfect any room unless the whole house is got evacuated. It should be used by a trained operator. *It is generated by* :—

(*a*) For disinfecting 1000 cubic feet space, 5 ozs. of potassium cyanide, 7½ ozs. of sulphuric acid, and 10 ozs. of water are mixed and the gas is generated.

(*b*) Cyanogen chloride and zyklon B are used.

(*c*) Cyanogas is largely pumped in rat holes by a cyanogas pump. The gas is slowly evolved and kills rats. 1 lb. of cyanogas powder is required for disinfecting 1000 cubic feet of space.

Disinfection of a first class railway compartment or of an ambulance car :—

All leather cushions should be mopped thoroughly with 10% formalin solution or washed with 5% izal solution. The water closet and floor of the compartment are to be sprayed with 10% solution of formalin in water. The compartment or the ambulance car is to be hermetically sealed and then fumigated with formaldehyde or sulphur dioxide gas.

Aerosols :—An aerosol is a substance which is capable of finally sprayed or of being dispersed in the form of a fine mist consisting of very minute particles. High dispersibility, rapid germicidal action and its nontoxic action to human beings or animals are properties of a good aerosal. Common examples are sodium hypochlorite, ethylene glycol and propylene glycol. 5 c.c. of 1 to 2% solution of sodium hypochlorite when dispersed as a fine mist in a room of about 1000 cubic ft. capacity kills from 90 to 95% of the suspended streptococci in the atmosphere of the room.

Concurrent disinfection :—It is carried out during the course of patient's illness. Its details are :—

1. Attendants' or nurses' hands should be immersed in phenol solution 1 in 40 or mercury chloride 1 in 1,000.
2. Clinical thermometer should be kept in phenol solution 1 in 20.

3. Feeding equipment, utensils and crockery should be boiled or scalded.
4. Remains of food should be destroyed by burning.
5. Nasal, faucial, ear or any other discharges or secretions should be taken up in gauze swabs and destroyed by burning.
6. Sputum should be received in gauze swabs or paper sputum cups and destroyed by burning. In tuberculosis hospital, it should be mixed with phenol solution 1 in 20 and allowed to stand for two hours before disposal into drain or else placed in a sterilising autoclave for 20 minutes.
7. Faeces :— (*a*) Mix with equal volume of phenol solution 1 in 20 or Bleaching powder and stir with a wooden stick and allow it to stand for two hours.

   (b) Sterilise in a steam steriliser.
8. Urine :—It should be treated with phenol solution 1 in 20 and allowed to stand for half an hour.
9. Textiles :—If soiled with albuminous discharge, they should be cleaned with soap. Except blankets, they should be boiled or disinfected with steam. Blankets may be soaked in 1 in 20 carbolic acid solution for 12 hours or sprayed with formalin or formaldehyde gas.

Terminal Disinfectants :—

1. Books, boots, furs, feathers etc., are best disinfected by exposure to 3% formaldehyde for 3 hours as they are rendered unusable by steam.
2. Dead bodies of persons who have died of an infectious disease should be wrapped in a sheet soaked in a powerful disinfectant. Cremation is very desirable in such cases and which should be hastened.
3. Bedding or body linen be disinfected by steam.
4. Room be disinfected by fumigation.
5. Floor and wall Surfaces : May be sprayed with coal-tar disinfectants 5% solution or with a 2% solution of formalin.

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CHAPTER XVI

INSECTS AND PARASITES

INSECTS

Insects are intimately related to man. They constitute a group of arthropods who have bilateral symmetrical bodies, jointed appendages, with heart situated dorsally, and nervous system ventrally. Their bodies are covered with a tough skin called *exoskelaton* and are divided into 3 parts namely the head provided with two antennae (*viz., feelers*), the eyes and the mouth parts; the thorax composed of three segments with three pairs of legs and two pairs of wings, and an abdomen composed for 9 to 11 segments. They have distinct sexes and are reproduced from eggs. They have visual organs in form of compound or simple eyes. They are not provided with lungs, but they simply breathe by means of a special type of tubular organs called trachea, which communicate with the external air by lateral openings called spiracles.

Classification :— 1. Wingless :—
1. Fleas.
2. Lice.
3. Bed bugs.

2. Winged :—
1. Mosquitoes.
2. Sand flies.
3. House flies.
4. Tserse flies.

WINGLESS INSECTS

1. Fleas :—They belong to the order of *siphonaptera*. They are wingless insects 2—3mm. long with laterally flattened hard, chitinous bodies consisting of head, thorax and abdomen. They are of small size and have bright colour. A flea has 3 pairs of legs.

Varieties :—There are hundreds of varieties but from the hygienic point of view the following are important :—

(*a*) Xenopsylla cheopis, X, astia, X braziliensis. They are Indian rat fleas. Xenopsylla cheopis is the common rat-flea in India and conveys plague. Xenopsylla Astia is not a carrier of plague. It is found in Madras and Colombo.

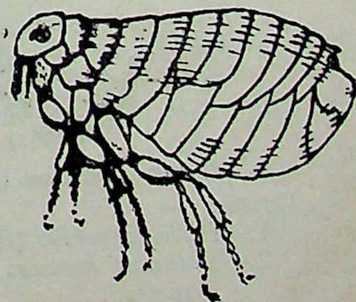


Fig. 50—Human rat-flea

(*b*) Nosopsyllus or ceratophyllus fasciatus (European or temperate climate rat flea).

(*c*) Ctenocephalus felis and canis (cat and dog flea).

Fleas borne epidemics. They are :—Bubonic plague, endemic murine and typhus.

Life history :—A female flea lays 8—12 eggs at a time singly in the hair of the host, which are oval, smooth, white and they soon fall to the ground. In summers within 2—4 days and in winter in 1 to 2 weeks time, the eggs hatch up and hairy larvae appear. The larva is very active and thrives on organic matters and develops into a pupa in 2 weeks' time by spinning a cocoon in which it pupates. It takes another 2 weeks for a pupa to develop into an adult flea.

Habits :—They prefer darkness and are very sensitive to light. They freely multiply. In absence of rats; when starved, they bite man. The males carry plague to rats more readily than females. They themselves travel about 20—30 yards but may travel far away if carried by a host or in the beddings or clothing of men or in grain sacks. They can jump upto 3 inches and crawl even upto 8". They are very active when prevailing temperature is 50°F or so. They are most common in dirty and deserted places and in places resided by people of unclean habits.

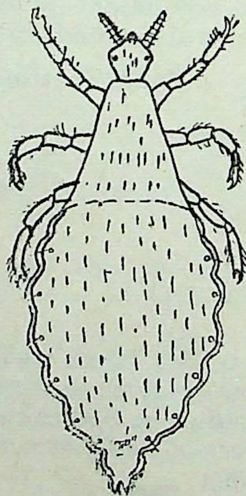


Fig. 51—Body louse (female)

2. Lice :—They are small wingless ectoparasities with hard chitinous covering and having three pairs of legs, each provided with a single claw. They live entirely on mammalian blood.

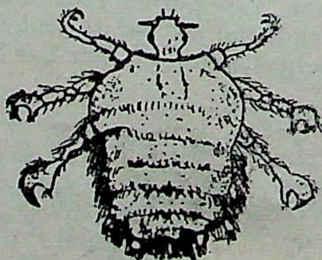


Fig. 52—Crab louse (female)

Varieties :—

1. *Pediculus capitis* (Head Louse).
2. *Pediculus humanus corporis* (Body Louse) or *Pediculus Vestimenti.*
3. *Phthirus pubis* (Pubic or crab louse) or *Phthirus Inguinalis.*

Louse borne diseases :—1. Typhus, 2. Trench Fever 3. Relapsing Fever.

There are two conditions for which head lice are often responsible :—

1. Swollen glands at the back of the neck and ear.
2. Impetigo due to scratching and infection of the sores.

Life history :—A female louse, within 48 hours of assuming adult form, produces nits or eggs. They are attached by the cement, secreted by the female, to the hair. They are oval, greyish white specks and provided with an operculum or granulated cap. The larva emerges in 6 days, begins feeding almost at once. In about 7 days time during which 3 moults occur, the insects become adults A louse takes 15 days' period to complete its cycle from an egg to the adult stage.

Habits :—The average life of a louse is from 35—58 days. Both male and female lice are blood-suckers. Infection is due to scratching the faeces of the lice into the skin. In addition, their bites are irritating, causing disturbed and insufficient sleep, especially in children. They may give rise to impetigo and other infections like dermatitis, etc., through secondary infection.

3. **Bed bugs** :—They belong to the order of *Hemiptera* and comprise a large number of species. A bed bug measures from 3 to 5 mms. in length and 1.5 to 2.5 mms. in breadth. It is dark brown, compressed and thin, so it makes its way into narrow cracks. Both male and female bugs bite. Its strong beak inflicts a painful wound. They prefer human blood and in its absence will feed on blood of rats and domestic animals. They are nocturnal in their habits, retiring during the day in hiding places. No insect is more difficult to eradicate from an infested building than the bed bug. The main difficulty is to get at it. Bed bug can live upto a year even without food.

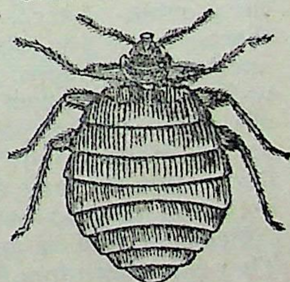


Fig. 53—
Bed bug (dorsal view)

Varieties :—

1. *Cimex lectularius* in temperate climates (Indian, bed bug).
2. *Cimex hemipterus* in tropics, or
3. *Cimex rotundatus* (Indian bed bug).

Diseases conveyed :—There is no disease which can be directly attributable to these but they cause irritation and annoyance and loss of sleep.

Life history :—Several times a year, the female lays from 1—12 eggs amounting to 200 or more during her life time. The eggs hatch in 7 to 10 days. Larva moults soon after a blood meal, if available and attains first nymphal condition and eaches the adult stage after four subsequent moults. In another two weeks it becomes sexually mature. The life cycle takes about 8 to 10 weeks.

Ticks :—As a class of *ectoparasites* they are found most abundant in warm countries as cold is unfavourable to them. They are very important blood suckers and play an important part in the transmission of disease. They attack all kinds of vertebrates, mammalia, reptiles etc. The bite though not painful at the time causes lasting irritation. As both males and females bite, both are transmitters of the disease. The female hands down the contagion to her progeny. They differ from insects in having four pairs of legs, only two pairs of mouth parts and having no antennae. They are nocturnal in their habits, so they remain concealed during the day.

Diseases conveyed :—These are tick relapsing fever and rocky mountain spotted fever or tick fever.

Life history .—A female tick lays 5000 eggs in a mass on the ground. After 2—3 weeks larvae hatch out. These attach themselves to a suitable host and feed, drop to the ground, moult and become nymphs. The nymph climbs on the blade of grass, waits to attach itself again to a host, feeds, drops and moults again to become an adult. The life history is completed in 1 to 2 years. Having thus reached maturity, the sexes unite. After fertilisation the male dies, while the female proceeds to feed on the blood of her host for the development of her ova. As it is difficult to find a suitable host, ticks can fast for a long time. They have been found alive even after a fast of 4 years.

Mites :—*Sarcoptes Scabiei* :—This is the itch mite. The male is 0.2 m m. and female 0.4 m.m. long. Both males and females have two pairs of anterior legs carrying pedicles with suckers. The female has two pairs of posterior legs with long bristles ; but the hindermost pair of legs in males have pedicles.

Life History :—The female burrows into the skin and lays upto forty eggs along the burrow. The larvae are hexapod nymphs. Some of these mould to become adult males. Others become second stage nymphs which in turn moults and become adult females. The period from the egg to the adult female is about fourteen days. The adult lives for four weeks.

Diseases caused :—Scabies or itch.

WINGED INSECTS

1. Mosquitoes :—They belong to the order diptera, and grouped under family *culicidae* and sub-family *culicinae.* They are distinguished by the presence of scales on their wings and proboscis. They are often referred as "biting flies" but they are infact piercing insects, for the jaws of the female are transformed into a needle like process with which to penetrate the skin when a blood meal is required.

The important anatomical characters of the adult mosquitoes are :—

1. *Proboscis* :—Bears various markings which vary according to the species.
2. *Antenna* :—In the male they are plumose and in the female they are pilose.
3. *Palpi* :—Are four jointed and may be very short or as long as or even longer than the proboscis.
4. *Thorax* :—Bears scales and markings which vary according to the species.
5. *Wings* :—The arrangement and the coloration of the scales depend upon particular species.
6. *Abdomen* :—It has eight segments and may show coloured bars.

Varieties :—The important varieties of mosquitoes in India which transmit the disease, are as follows :—

A.—Anopheles :—

1. *A. minimus* :—It is a vector in North Bengal, Doar, Assam and Southern India. It breeds in clear unpolluted slowly running water, with grassy edge, as in a stream or an irrigation channel. It also breeds in wells and cisterns.

2. *A. fluviatilis* :—It is a vector in foot hill areas, from North West Frontier to Assam and other parts of India such as South India, Mysore and Travancore. It also breeds in clear unpolluted water like *A. minimus* and in slowly running water, streams, drains, etc.

3. *A. culicifacies* :—It is a vector, widely distributed in India except in Bengal, Assam and Jaipur hilly tracts. It is found particularly in North West India. It breeds in clear water, in irrigation channels, in sluggish streams often with sandy margins and on little vegetation in sheets of fresh rain water. It also breeds in rice fields, burrow pits, shallow wells and pools.

4. *A. stephensi* :—It is essentially an Indian species and is widely distributed in India especially in Western and North West India, urban areas of Calcutta, Delhi, Bombay and Madras. It breeds in wells, cisterns, fountains, receptacles, etc. In rural areas it breeds in pools, margins of streams, in seepages and marshy areas, in springs, shallow wells and garden pits containing seepage water. It can also breed in salt water.

5. *A. philippinensis* :—It is a vector in West and Southern Bengal, Assam and Southern India particularly in rural areas. It breeds in tanks, ponds, dobas but never in rice fields.

6. *A. sundaicus* :—It causes malaria in coastal area of Bengal, Orissa, Andamans, Nicobars, Eastern part of Calcutta and Bengal. It breeds on brackish water, fish ponds, salt lakes, etc.

7. *A. superpictus* :—It is a vector of limited distribution in India and does not play an important role in transmission of malaria in India. It has a marked preference for running water exposed to sunlight occurring mostly along the edges of streams and rivers. It also breeds in marshy areas, open irrigation channels, wells, springs and reservoirs.

8. *A. annularis and A. varuna* :—They are vectors in Assam and Bengal. They are weak carriers and breed in stagnant waters of all types.

B. Culex :—*Culex fatigans* :—They frequently breed in cesspools, gullytraps, drains, masonary tanks, earthenware vessels and in collections of water around houses and stables. They are responsible for the propagation of filaria.

C. *Aedes aegypti or Stegomyia fasciata* :—They are responsible for the transmission of dengue and yellow fever. They breed in small artificial collections of water, such as barrels, puddles, cisterns, old tins, broken tins etc. They are domestic

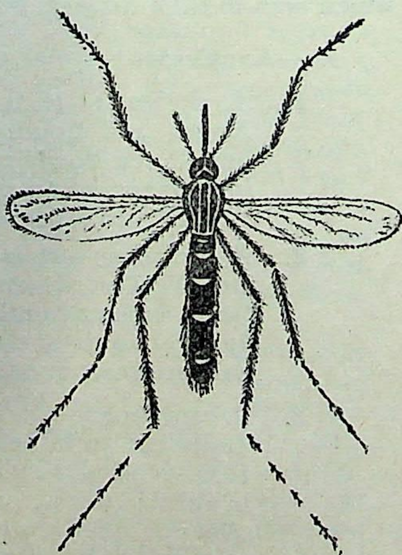


Fig. 54—Aedes Aegypti

in their habit and are therefore very dangerous. They seldom fly far away from breeding places.

Life history of mosquitoes :—The male mosquito feeds on vegetables where as the female feeds on the blood of the host. During the course of the season, the female mosquito may lay eggs several times and several hundreds at each time.

The male mosquito lives rarely more than 1 to 3 weeks. The female may live upto 4 months or more. Mosquitoes prefer dark to light colours. The anopheles type of mosquitoes avoid both heat and light and therefore during the day they remain concealed in the corners of rooms etc. At night they come out from their hiding places in search of their food. The females bite men and animals as they are blood suckers and that is why their proboscis is particularly modified for piercing the skin. Provision of the blood meal is essential for the female mosquito before producing a batch of eggs. Anopheles mosquito does not make any noise while flying about. The bite of anopheles is not very painful. Mosquitoes bite voraciously when the relative humidity of the atmosphere is high. During winter, in cold countries and in the hottest months in tropics, the female adults hibernate in sheltered places. This is known as aestivation.

Anopheles do not seem to fly more than ¼ to ½ mile, from their breeding places, but if the breeding is profuse, habitation scarce and the direction of wind favourable, it may go even upto 1½ to 2 miles.

Life cycle :—The female mosquito, after sucking blood lays eggs on the surface of water. The anopheles female lays 100—250 eggs in each batch. They are boat-shaped and are deposited singly. They are difficult to be detected with the naked eye and resemble minute specks of dust in appearance, In case of female culex, hundreds of eggs, usually 200 to 500 are laid at a time and are cemented together in the form of rafts.

In 2-3 days the eggs hatch out and a small wormlike larva appears from each egg. It consists of a flattened head, with a pair of large eyes, a globular thorax and abdomen but no legs. The head has got strong mandibles for biting. They have got respiratory apertures. These larvae feed greedily on vegetables. They are found in stagnant pools and slow running streams. Anopheles larvae are provided with palmate hair and they float-parallel to the surface of water. The larvae of culex and aedes have syphon tubes, so they hang almost vertically with their heads downwards.

The larva casts its skin 2 or 3 times and finally attains its full size in 8-10 days, when it changes into a comma shaped

creature called pupa. It has got a large globular body and a small tail. It is very active and swims rapidly by lashing its hinder part about. It does not breathe through its tail like the larva but does so by means of tubes which project on the dorsal side. It has no mouth and hence it does not eat.

In 2-3 days it splits up and an adult mosquito or the imago emerges. It has a rounded head with prominent eyes, two antennae, two palpi, a prominent suctorial or piercing organ—the proboscis, an oval chest, about the size of head, to which is

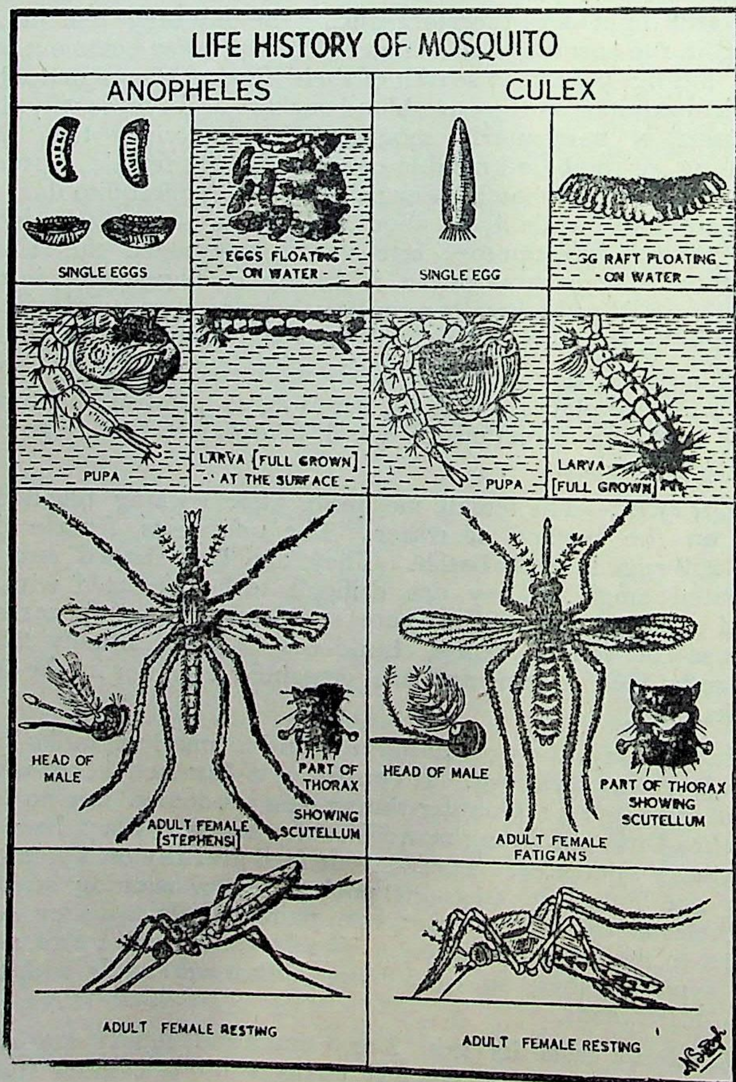


Fig. 55

attached a pair of wings and three pairs of jointed legs. The abdomen is segmented consisting of 10 segments of which however only 9 can be distinguished. The males are distinguished from the females by the presence of the whiskers or plumes on either side.

Distinguishing features of Anopheles and Culex.

	Anopheles		*Culex*
(*i*)	Adult :—(*i*) Resting attitude :—The head, thorax and abdomen are in a straight line (except A. Culicifacies)	(*i*)	Hump backed attitude, with body more or less parallel to the surface. Head or body are inclined at an angle to one another.
(*ii*)	Proboscis :—in one line with body and head.	(*ii*)	Not in line with the body.
(*iii*)	Palpi as long as proboscis in both sexes but clubbed terminally in males.	(*iii*)	Very short and two knob like in females.
(*iv*)	Scutellum : bar shaped.	(*iv*)	Trilobed.
(*v*)	Wings : — frequently spotted.	(*v*)	Plain.
(*vi*)	Scales :—no scales on belly.	(*vi*)	Scales on belly.
(*b*)	Breed in clean, fresh water. Some prefer still water, while others prefer running water. Some breed in saltish and brackish waters.	(*b*)	In still water, cess pools, gully traps, drains, earthenware vessels, around houses and stables, often in collections of dirty waters.
(*c*)	Eggs :-boat shaped, laid singly 100—200 in number, often form patterns, on the surface of water, *e.g.*, triangular and star shaped.	(*c*)	Ovate or cigar shaped. Laid in batches. 200-500 in number, found cemented together in rafts of hundreds of eggs.
(*d*)	Larva :—small head. Has no respiratory syphon or breathing tubes. Lies horizontally with the surface of water. Has palmate hair (except A. *umbrosus*).	(*d*)	Large head, has a long conspicuous syphon tube. It lies at an angle with the surface of water. It hangs downwards when it breathes. Has no palmate hair.

(*e*) Pupa :-Breathing trumpets are funnel shaped. Accessory paddle hair grown above the origin of the paddle hair.	(*e*) Breathing trumpets are long and narrow. Accessory paddle hair grown besides the paddle hair or may be absent.

Aedes aegypti or Stegomyia fasciata or tiger mosquito :—This is a domestic mosquito and is characteristically marked with black and white stripes. It has unbanded proboscis, white mark on the dorsum of thorax called lyre, and the cross bands on the abdomen. It is recognised by the broad, flat, imbricated scales completely covering the head and abdomen, which are invariably present on the middle lobe and frequently on the lateral lobe of the scutellum also. The scales impart a satiny appearance which is characteristic. They are mostly small and have alternate white and black bands on the abdomen. The females are blood-suckers and bite both during day and night. Each female lays about 20—25 eggs separately instead of being cemented together to form rafts, in cisterns or rain water. They are black. The syphon of the larva is short and dark in colour.

2. **House fly** :—The commonest variety of house fly is called *Musca domestica*. It belongs to the family *muscidae*, of the order diptera. It is $\frac{1}{4}''$ in length, having mouse grey colour and 4 narrow black stripes on thorax. It has got a proboscis, which is not capable of piercing but is used for sucking food.

It breeds chiefly on human and animal excreta particularly horse manure, cowdung, decaying and fermenting vegetable and animal matter, carcases and putrefying filth which provides food and home for maggots. It cannot breed in very dry materials.

Life cycle :—A female house fly lays 120—500 eggs at a time and four such batches in a season. The favourite site is on the surface of fermenting vegetable matter or fresh dung of horse, pig or man. The progeny of a single house fly will number 432,000 in seven weeks. The eggs look like tiny grains of polished rice. The development depends upon the atmospheric temperature and the characteristics and temperature of food.

The larvae or maggots :—Within 1 to 2 days the eggs hatch into white legless crawling creatures called maggots. They grow rapidly and burrow into food material on which they feed. The maggots shun light and disappear during the day and come out at night. They eat voraciously.

The Pupa or Chrysalis :—In about 3—5 days, the larva enters into resting stage. It is passed within a barrel shaped shell usually $\frac{1}{4}''$ in length, which is oval, brown and quite immovable.

The adult fly :—In 5 to 7 days, depending upon the temperature, it ruptures and a full grown fly comes out, which

has a shrunken appearance and incapable of flying. The wings soon spread out, the outer covering of the body and legs harden and the fly looks quite normal. The duration of the cycle is 10—20 days, depending upon the temperature. The greater the temperature, the quicker the cycle.

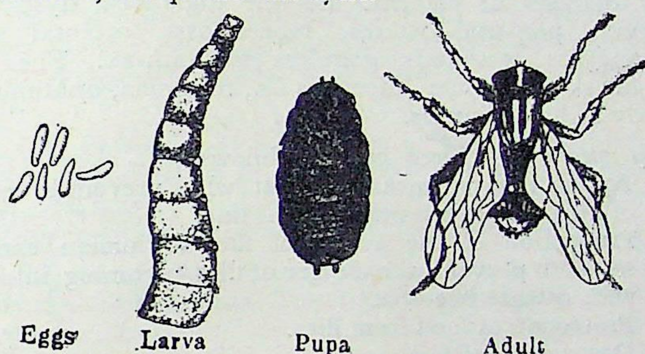


Fig. 56—Life stages of Housefly.

Mode of Infection :—A house fly does not bite and therefore cannot inoculate a person in a direct manner. The house fly is a mechanical carrier of disease. Its hairy body, legs and wings become covered with filth on which it feeds or crawls. This material which may be infected with pathogenic germs is frequently deposited subsequently on human food. Furthermore, in the fly's alimentary canal bacteria live unharmed, until they are discharged in the excrement or regurgitated in small drops which are called "vomit spots."

The fly infects food in two ways, *i.e.*, mechanically and vitally, *e.g.*, the fly sits on typhoid or cholera infected stools. It then flies to a glass of milk. It infects milk in two ways :—

1. Mechanically, by having filth washed off its legs.
2. Vitally by vomiting and defaecating in milk : Experiments have shown that the flies infected with typhoid and anthrax germs can remain infected for weeks and there is some evidence to show that the typhoid germs swallowed by a maggot born in typhoid infected stools may persist in adult fly.

Flies have a limited range of flight, *i.e.*, they are generally moving in a circle of about $\frac{3}{4}$ mile of radius. In India they can be carried to long distances by human beings, animals and other means of merchandise. They are not long lived. Under favourable natural conditions their maximum life is probably 60 days. They are subjected to a natural disease, which kills them in large numbers in autumn. The increase in number of flies is definitely associated with the climatic conditions of temperature

and humidity prevailing during the summer months, *i.e.*, June and July. These climatic conditions favour the rapid multiplication of flies.

Diseases spread by flies :—They are responsible for conveying many diseases as cholera, infantile diarrhoea, dysentery, typhoidfever, parasitic worms, tuberculosis, oriental sore, leprosy, maggots in wounds, glanders and anthrax. Flies also convey some skin and eye infections *i.e.*, trachoma, ophthalmia, particularly in hot countries.

Antifly measures :—They are as follows :—

(*i*) Application of measures that will prevent breeding of flies. This is a most logical line.

(*ii*) Prevention of the access of flies to human excreta so as to prevent the danger of flies becoming infected with disease bacteria.

(*iii*) Protection of food from flies.

(*iv*) Destruction of flies.

I. *Prevention of breeding of flies.* (*i*) It aims at prompt removal and proper disposal of all refuse including horse manure, cowdung, night soil etc. The conservancy arrangements should be efficient. Attention should be paid to the general sanitation and cleanliness.

(*ii*) Refuse should not be allowed to accumulate in the stables, cowsheds, slaughterhouses, fishmarkets, garbagedumps etc. They should be regularly cleaned at least once a day and refuse should be removed in covered carts to the closed pits. Manure and Organic matter of all kinds are unfavourable for fly development if they are perfectly dry. Therefore the spreading of manure in thin layers on fields where it will be immediately dried by the sun is a safe method of disposal

(*iii*) For destruction of eggs, larvae and pupae of flies in the manure, substances toxic to flies in their various stages are used, which would not affect the fertilising power of the manure. An extract of Hellebore ($\frac{1}{2}$ lb. of the powder to every 10 gallons of water) is best for the purpose. Powdered borax is a more effective larvicide than hellebore (one lb. for 16 cubic feet of manure) and it can be applied in solution ; D.D.T. is of little value against the destruction of fly larvae but gammexane and chlorodane are effective. Sodium arsenite spray is also tried on manures and breeding places. If the manure is packed closely, the heat of fermentation will kill the larvae, with the exclusion of air.

II. *Prevention of the access of flies to human excreta* :—(*i*) Human excreta should be properly disposed of, by water carriage system. It gives most complete protection from the possibility of fly carrying diseases.

(*ii*) Fly-proof privies and latrines with self-closing seat covers should be used. Nightsoil should be collected in fly-proof airtight receptacles and removed in covered nightsoil carts.

(*iii*) Persons using a latrine or a privy should cover up their excreta completely with earth or sand to prevent access of flies. Crude oil may be used liberally. The use of various disinfectants on accumulations or surface toilets is of no particular value.

(*iv*) In fairs and camps deep trench-latrines with fly proof seats should be used. The trenches should be deep and well covered with earth.

III. *Protection of food from flies* :—

1. Screens, chicks, wiregauze-doors and windows should be provided for all human habitations, restaurants, hotels, confectionary stores, meatmarkets etc., to prevent contamination of food by flies.
2. The practice of displaying vegetables and other foods meant for eating uncooked on tables or in stalls which are open to flies be discouraged. This can be remedied by placing the food in glass cases or fly-proof almirahs or covered with fly-proof covers.
3. Electric fans may be used to force a current of air over the food products on display, to prevent the flies from settling.

IV. *Destruction of adult flies* :—They are killed in many ways, which are not only expensive but also temporary in value.

1. Fly papers and strings or tanglefoot are made by heating together 5 parts of castor oil and eight parts of resin powder and then spreading in thin layers on glazed papers or strings. They are effective as long as they remain tacky. They are placed in rooms. Flies stick to them and die.
2. Fly traps of many varieties are available in the market. Conical hoop flytrap is most effective and economical. The bait is placed in a shallow pan on the floor directly under the apex of the cone, placed inside a cylinder made of screen wire. The flies are attracted by the odour of the bait. Other variety is the tent-trap, which is a modification of conical trap. The flies are subsequently killed by fumigation.

3. Flies are killed by wire mesh or leather flaps attached to the handles.
4. Poisonous baits may be used. 2% formalin solution with little sugar and milk is placed in the rooms to attract flies. They being thirsty insects, are always attracted towards water or the solution and die after drinking. Sodium arsenite solution (one oz. to a gallon) may be used for the same purpose.
5. Spraying of D.D.T., pyrethrum in kerosene *i.e.*, 5% solution or emulsion will kill flies. Two quarts of solution or emulsion is required for 1000 square ft. area to obtain a residual of 200 milligrams per square foot.
6. Keating's insect powder is sprinkled over table cloths, etc.

The lay public should be convinced that housefly is a carrier of the disease and must be educated regarding the adoptation of antifly measures.

Sand Flies :—They belong to family *Psychodidae*. They are present in holes and crevices where moisture is present.

Varieties :—There are many varieties of sand flies. The most common are :—

1. *Phlebotomus papatasii* (vector of sand fly fever and oriental sore).
2. *Phlebotomus argentipes* (vector of kalazar)
3. *Phlebotomus sergenti* (vector of oriental sore).

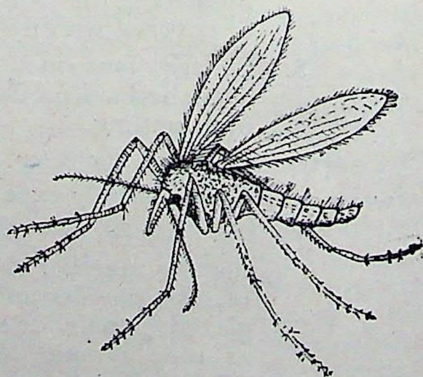


Fig. 57—Phlebotomus papatasii

These are small yellowish brown flies, with long proboscis, humped thorax, hairy body and butterfly wings. They possess slender legs and can pass through 18 to an inch mesh of mosquito curtain. They dislike sun and wind ; remain in the dark by day time and bite vigorously at night. The range of flight of the adult is very small.

Life history :—The female sandfly sucks blood before ovipositing and lays about 40 eggs in moist places like the walls of cellars, latrines, cesspools and embankments and also where

food-refuse undergoes decomposition. Eggs hatch into larvae in 7—10 days time. The larva lives in organic matter and grows into a pupa in 14 days. Pupa becomes an adult fly in another 10—14 days. The whole life cycle takes 6—12 weeks to complete.

Diseases transmitted through sand flies are :—Sandfly fever, oriental sore and leishmaniasis or kalazar.

Anti-sandfly measures :—The preventive measures consist of extirpation of breeding places *i.e.*, removal of cattle from dwelling houses or making cattle sheds pucca. Sandfly net with 45 mesh to a square inch may be used to protect one from their bites. Destructive measures are same as mentioned under house fly.

Tsetse Flies :—They carry the trypanosomes of sleeping sickess in Tropical Africa. They are ordinary looking, sombre brownish flies varying from 3½ to 4 lines in *Glossina morsitans* and to about 5½ lines in that of *Glossina fusca or Longipennis* with a prominent proboscis in all species. They require abundant and dense shade. The undergrowth along courses of rivers, ravines and shores of lakes are suitable localities.

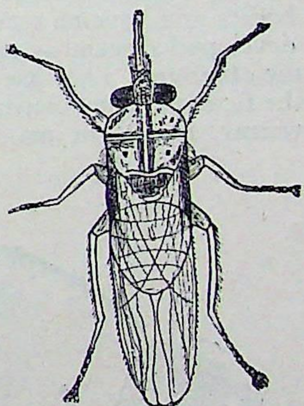


Fig. 58—Tsetse Fly

Both the male and female flies are voracious blood suckers and attack both men and animals. They bite exclusively during the day. The bite is painful. The flies become infective about 34 days after feeding and remain infective for 70-80 days and probably even for the rest of life.

Varieties :—The commonest ones are :—

1. *Glossina palpalis.*
2. *Glossina morsitans.*

Disease transmitted :—Sleeping sickness.

Life history :—The female does not lay eggs but gives birth to a single mature larva in a carefully selected spot (light soil with some degree of shade). Immediately after birth the larva buries itself and pupates in 3—4 weeks time.

ANIMAL PARASITES

Parasitic animals may be defined as those animals which live within or upon other living organisms called hosts for purpose of deriving their nourishment from them. Some parasites nourish themselves on the material, *e.g.*, the blood or the lymph

of their host. Saprophytic parasites derive their nourishment from dead material. Many parasites are pathogenic.

There are many ways by which man may get infected; the most common mode being the ingestion of eggs or immature forms of parasites together with water or other fresh food. Infection may occur due to ingestion of immature parasite in an intermediate host. It may be transmitted by the direct agency of second host, as in filaria.

The common animal parasites that effect human beings are as follows:—**Helminths** :—They are triploblastic worms consisting of epiblast, hypoblast and mesoblast. They may be considered under three classes *viz.*, nematodes, cestodes and trematodes.

1. Nematodes or Round worms :—They have slender bodies and have no segments or appendages. They have well developed alimentary canal, with mouth at one end and anus at the other end. They are bisexual. The males, are smaller than the females. The following are some of the important parasitic worms found in man :—**1.** *Ascaris lumbricoides* :—It resem-

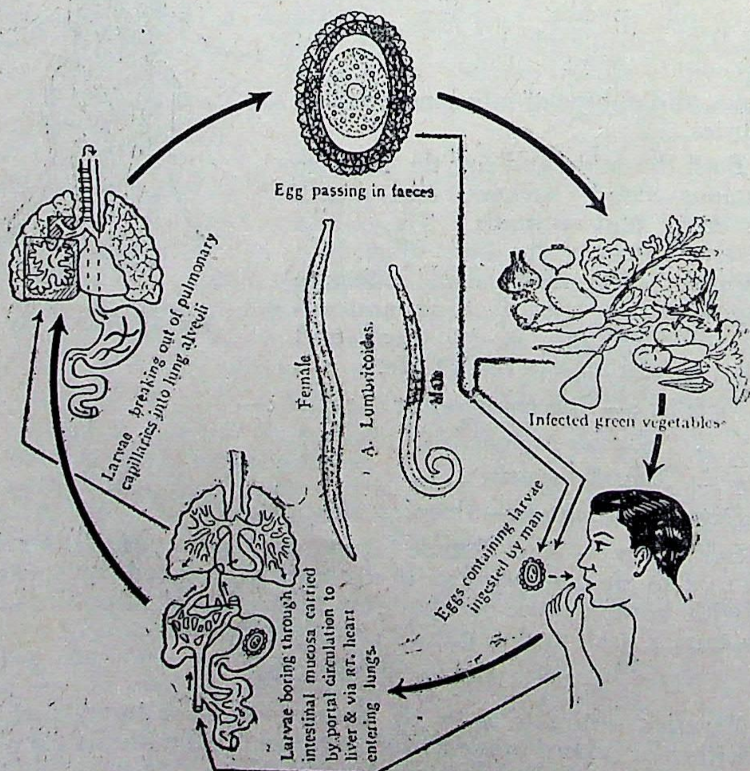


Fig. 59.—Life cycle of Ascaris Lumbricoides.

bles the common earthworm being cylindrical and pointed at both ends, of pinkish grey colour, with glistening surface when alive. The adult female measures about 12″—14″ and the male about 3″ to 10″ with its posterior extremity curved anteriorly. The female lays enormous number of eggs, that have resistant shell, outside which there is often a clear irregular albuminous sheath. The egg is non-infective until a larva has developed. This maturation takes a few weeks while it is laying in the soil.

Mature eggs containing embryos are ingested via contaminated food, vegetables and fingers. When swallowed, these eggs find their way in the duodenum, where the shell dissolves and the embryo emerges, perforates the mucous membrane of the intestine, enters lymphatics and veins and reaches right side of heart and from there passes on to the lungs by blood stream. It then penetrates the lungalveoli, migrates up the trachea, down the esophagus to reach intestines and becomes an adult to lay eggs. They may be sometimes found matted in the intestines thus causing intestinal obstruction.

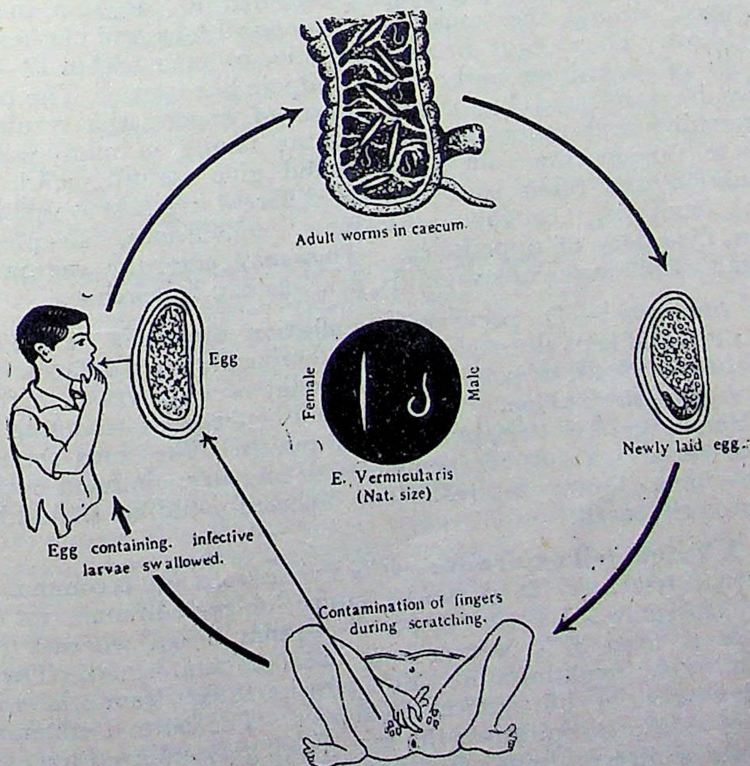


Fig. 60—Life history of Oxyuris Vermicularis.

Prevention :—It depends upon—1. Satisfactory disposal of nightsoil.

2. Vegetables eaten raw should be washed under running water preferably with water containing potassium permanganate. Use boiled water for drinking.

3. Treatment of all infected persons.

4. Attendance to personal hygiene.

2. **Oxyuris vermicularis or Thread worms**:—They are found mainly in children. The female is $\frac{1}{3}''$ to $\frac{1}{2}''$ long and the male usually half of its size. They develop from ova in about 3 weeks time.

Life cycle :—The eggs are swallowed and larvae hatch out in duodenum. They pass down to caecum where they develop into adult worms and attach themselves to the mucosa of caecum and large gut. The female soon migrates outside the intestinal canal through the anus and deposits her eggs on the perineal skin. The eggs remain attached to the skin, in the grooves, around the anus, in the perineal hair and clothes of the host. These eggs become infective to man within 12—36 hours of deposition and contain tadpole like larvae. The host may be reinfected by contamination of fingers as a result of scratching and other members of the family in many ways. These worms crawl out of anus and give rise to much local irritation and often lead to many different types of symptoms *e.g.*, enuresis, cough, restlessness, convulsions, sleeplessness, disorders of appetite etc. They may enter the vagina in females and cause vulvovaginitis, pruritus and leucorrhoea.

Prevention :—To prevent autoinfection the nails should be cut short and kept clean and washed thoroughly after defaecation and before meals. If possible child should wear gloves at night. He should sleep alone. There should be frequent changing of bed linen, underclothes, pyjamas and towels. The anus should be smeared with dilute ammoniated mercury ointment every night before going to bed. The infected children should be isolated till cured.

3. **Trichinella spiralis** :—It is a viviparous and is commonly known as trichina. It passes its entire life cycle in man, rat or pig. The male is 1.5 mm. long and 0 04 mm. broad whereas the female is from 3 to 4 mm. long and 0.06 mm. broad. Their habitat is the small intestine. The parasite differs from others in passing its entire life cycle in each host. The normal common host of trichinella spiralis is the pig which gets infected by eating rats or directly from infected offal and the larvae are embedded in the muscles.

When the trichinous meat is eaten by man or by another animal, the capsules are dissolved, the larvae are set free in the small intestines and in about 2 days they grow into full mature worms. The adult worm lies in the duodenum and jejunum. The female parasite produces more than 500 young embryos at a time which pierce the bowels and are carried by circulation to active voluntary muscles. In about 7 to 9 days, the larvae get encysted in the muscles. They may remain in this form for 8 months, after which they calcify and the larvae finally die.

Trichiniasis in man is a serious disease and is characterised by fever, preceded by diarrhoea. Soon there may be severe pain and aching in muscles with oedema, and cachexia. When there is excessive worm infection there may be inflammation of the intestines with severe and fatal haemorrhages. The blood usually shows an increase of eosinophiles, even up to 70%.

Prevention :—

1. Proper inspection of meat by a veterinary surgeon and rejection and destruction of infected meat.
2. Thorough cooking of meat. The larvae are killed at a temperature of 160° F.
3. Destruction of rats in and around the slaughter house so that the pigs may not eat them and get infected.

Treatment :—There is no drug known to be specific for this disease. Any how piperazin citrate can be given with advantage on the onset of disease.

4. Wuchereria :—The two common species in India are :—

1. *Wuchereria (filaria) bancrofti.*
2. *Wuchereria malayi.*

1. *Wuchereria bancrofti* :—They are prevalent in certain parts of India. They are long threadlike worms, the male is under 2″ and the female about 3″ in length. Both sexes live together, often coiled about each other in lymph channels. The parasite has a fine sheath, in which it moves backward and forward. They complete their life cycle through parasitism in two sets of hosts *i.e.*, man and mosquito *culex fatigans*.

The culex mosquito sucks the blood of an infected person during the night. The embryos exhibit nocturnal periodicity *i.e.*, during the night, they enter the peripheral circulation: during the day they remain in lungs and larger arteries. If the individual changes his habit and sleeps during the day, the embryos eventually appear in the perepheral vessels only during the day time. The embryos or microfilariae enter the stomach and soon migrate into the thoracic muscles, of the

mosquitoes where they pass through series of developments lasting for 10—14 days. There is no multiplication of microfilariae. They finally migrate to the proboscis of mosquito. When this mosquito bites a healthy person, the infective larvae find their way at or near the site of the puncture in skin and eventually reach the large lymphatic trunks where they slowly grow into maturity (in about a year or so). The female parturates and the embryos are carried via lymphatic trunks into thoracic duct and from there into the general circulation of blood.

Effects :—The most common effect is periodical attacks of lymphangitis with fever, elephantiasis and chyluria. Once elephantiasis is developed, no filariae are found in the blood, because all the embryos get locked up in the lymphatics.

Prevention :—One must protect one-self from the bite of culex mosquito by sleeping under mosquito net. Anti- mosquito measures should be taken. Patient should be segregated and treated.

5. Dracunculus (Filaria) medinensis or Guinea worm :—In India this is largely prevalent in Bombay and Madras Presidencies, Mysore, Rajasthan etc. The male, which is 1½ inches long, has not been found in man. A fully grown female worm is from 16 to 48 inches long and about 1/17 inch in diameter. The worm is round, smooth and of milky white colour. It is threadlike and nearly the whole of the worm is occupied by uterus stuffed with embryos. Roughly speaking there are about 3 million embryos per worm. The worm is chiefly found burrowed in the subcutaneous tissues of the leg and sometimes of the back. At the site of choice the worm secretes an irritant substance, which gives rise to a blister. It breaks the uterus of the worm, prolapses in contact with water and discharges a milky looking fluid, containing myriads of embryos. These larvae pass into water and are taken up by the minute

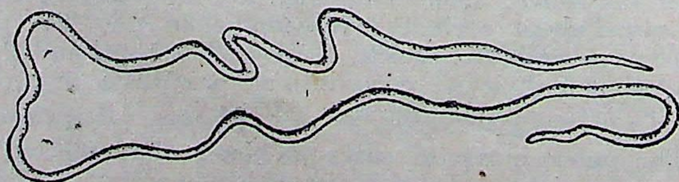


Fig. 61—Female Guinea worm (Half life size)

cyclops, within which they undergo larval development in about five weeks' time.

A healthy person gets infection by drinking the water containing the infected cyclops; the gastric juice kills the

cyclops and sets free the larvae which burrow and find their way into the subcutaneous tissues. It takes about a year for the worms to mature.

Prevention :—

1. Do not allow any one to enter a well or a tank.
2. Strain the water through a muslin cloth or boil it before drinking.
3. Disinfect the well water with potassium permanganate or calcium oxide (1 drachm to a gallon). Lime is also found to be very effective for killing cyclops.
4. Barbel fish (barbus puckeili) destroys cyclops and larvae of guinea worms so they may be introduced in wells and tanks.
5. Step wells should be converted into draw wells so that physical contact with water by infected persons is completely eliminated. Step wells should be totally abondoned.

6. **Ancylostomum duodenale or Hook worm** :—The infection is common in Europe, Egypt and India.

There are two distinct varieties :—

1. *Ancylostoma duodenale.* 2. *Necator americanus.*

Necator americanus is comparatively shorter and more slender than ancylostoma duodenale.

A typical hookworm is almost cylindrical, the male 6 to 10 m. m. and the female 8 to 18 m. m. long. Its body is thread like with a conical shaped head and a large oval mouth fitted with four claws or hook like teeth on the ventral side of the buccal cavity and two knob like teeth on the dorsal side by which worm fixes itself to mucous membrane of the intestines.

An infected person passes a very large number of ova in the faeces, which have been estimated sometimes to be over 4,000,000 and when they happen to be laid on moist earth, further development takes place and in about 5 days' time, larvae moving actively in their sheaths, are seen crawling up the blades of grass. They can live in this stage for months when moisture and shade are present, but are rapidly killed by drying. The larvae passes through two moults before becoming infective. So temperature, rainfall, humidity and condition of soil are important factors to influence the spread of infection. This is the infective stage, when the larvae enter human beings through hair follicles, sweat glands or microscopic fault in epidermis. It causes dermatitis which is known as ground itch, ground sore or toe itch. After reaching the subcutaneous tissues they enter the lymphatics or veins and are carried into the heart and from

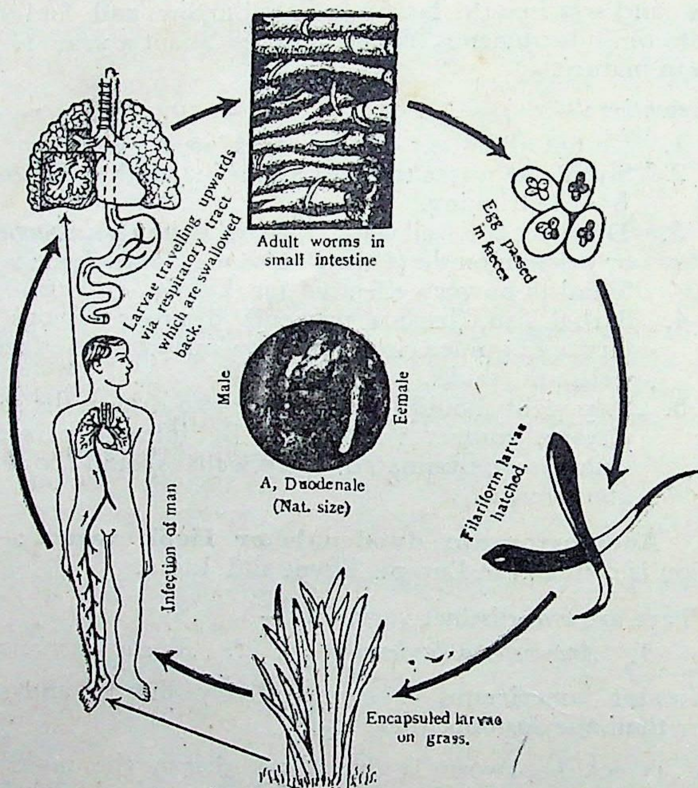


Fig. 62—Life History of Ancylostomum duodenale

the heart into lungs and bronchial tubes from where they are swallowed. If swallowed they reach the stomach, lose their protecting sheath, pass into the intestines and develop into the adult worm in about 4 weeks; they then attach themselves to the mucous membrane of the intestines, duodenum and jejunum and cause haemorrhage which gives rise to anaemia. It may cause debility, puffiness of face, abdominal pain, flatulence, constipation, alternate diarrhoea and constipation, oedema of legs, palpitation etc. Thus anaemia becomes apparent pallor of the whole body, especially of conjunctiva and tongue becomes marked. The tongue generally looks like a sheet of white blotting paper, which it is rarely seen in any other condition except bleeding piles. Moreover, the disease is more common in females than in males because females usually choose segregated places well protected from view and go to the same spot every day and thus they are brought into contact, with heavily infested soil again and again. Men on the other hand use random convenient places and thus escape heavily infected

localities. During their journey in the body, these moult twice, which are in addition to two moultings outside.

General effects on community :—

1. Loss of efficiency of manpower among labourers.
2. Lower resistance of affected persons.
3. Retardation of physical and mental development of children, thus delaying puberty.
4. Sterility, abortion, an impaired lactation in women.

Prevention of hook worm infection :—

1. Faecal contamination of soil, water and vegetables which are eaten raw, should be prevented.
2. Faeces should be properly disposed of by installation of sanitary types of latrines. In villages bore-hole or dugwell latrines should be provided.
3. The infected persons and healthy carriers should be treated after isolating them *i.e.*, the source of infection should be isolated.
4. Water supply should be protected from getting contaminated.
5. Personal protection of individuals by use of boots, shoes, etc. They should not go bare-footed. Personal hygiene should be attended to.
6. *Propaganda* :—The public should be educated regarding the prevention of disease through hand-bills, posters, lectures, films, slides, etc.

Treatment :—Now a days olden methods of treatment by thymol, eucalyptus mixture etc., have been replaced by carbon tetrachloride and recently by tetrachlorethylene. Carbon tetrachloride has to be prescribed cautiously since it has caused toxic manifestations and even death in many occasions. Tetrachlorethylene on the other hand can be safely given even to the children without any fear of toxic effect.

II. Cestodes, Flat worms or Tape worms :—The common forms of tape worms are :—

1. *Taenia solium.*
2. *Taenia saginata.*
3. *Dibothriocephalus latus.*
4. *Hymenolepis nana* or dwarf tapeworm.
5. *Taenia echinococcus granulosus.*

They are found in intestines. They pass through two different phases in two different hosts. The worm, consists of a minute head, a neck and row of segments. The worms are devoid of any digestive organs. They are long, flat and tape like worms and are found in the intestines. They are generally segmented

and are white or yellow in colour devoid of any mouth or alimentary canal. The worm consists of a minute head called "*Scolex*" the whole body or the "*Strobila*" and the individual segments as "*Proglottides*". The length varies. It may be as long as 4 metres or as small as ½ centimetre.

They pass through two distinct phases in two different hosts known as definitive and intermediate hosts. Man is a definitive host for the taenia saginata and dibothriocephalus latus; intermediate host for taenia echinococcus granulosa and both definitive and intermediate hosts for taenia solium and hymenolepsis nana.

Life history:—The proglottides (ripe segments containing uterus) are dislodged from the parent worm and passed out with the faeces when the ova are set free and which retain their vitality for some time.

The ova at this stage are eaten by some animal which is capable of acting as an intermediary host, *i.e.*, pig, in case of taenia solium and cattle in case of taenia saginata, and fish in case of dibothriocephalus latus, etc. They continue their development till the shell is dissolved in the intestines and the embryo with six hooklets is set free. These hooklets enable the embroys to penetrate the intestines to the solid tissue-like muscles of the host where they develop into cysticercus stage (which is known as cysticercus cellulosae in case of pig) which remains passive in the flesh, until it is eaten by man, which acts as a "definitive host". In the stomach of the man the capsule is dissolved by the gastric juice and the scolex or head is set free which finds its way in the intestines. The head, by means of its hooks, is fixed to the intestinal wall and develops into a fully grown tape-worm within eight weeks. It then begins to pass proglottides charged with ova in faeces, which are ready to commence a new cycle.

1. **Taenia solium** :—The worm is 10 ft. long or more consisting of 700 or more segments. The head is of the size of a pin and is provided with four suckers. The intermediate host is both pig, and the man. The egg must be swallowed by the pig. The egg-shell is digested and the embryo is set free. By the lymphatic system it reaches the muscles (tongue, neck, shoulder and diaphragm), brain, eye etc. and by losing its hooklets develops into a bladder like larva (cysticerus). These cysts are usally of the size of a pea. Pig's meat infected in this sway is known as "measly pork". Man is infected by taking uch insufficiently cooked meat, generally in sausages. Man is also liable to become infected accidentally with the cysticercus stage by swallowing eggs from his own infective faeces.

2. Taenia saginata or taenia mediocanellata :—Its length is 3-4 metres or 25 ft. or more. Head and proglottides are similar to those of taenia solium. The intermediate host is cow. It forms cysticercus in the bovine flesh and this is known as beef measles. When the animal is killed for food, the cysts should be discovered during inspection, otherwise if the beef is undercooked, the cysts will develop in the intestines of the persons who eat it and produce new tape worms.

Symptoms :—Usually infected person sees segments in a stool. These may be indigestion, colic and either anorexia or voracious or perverted appetite and nerve symptoms may sometimes occur.

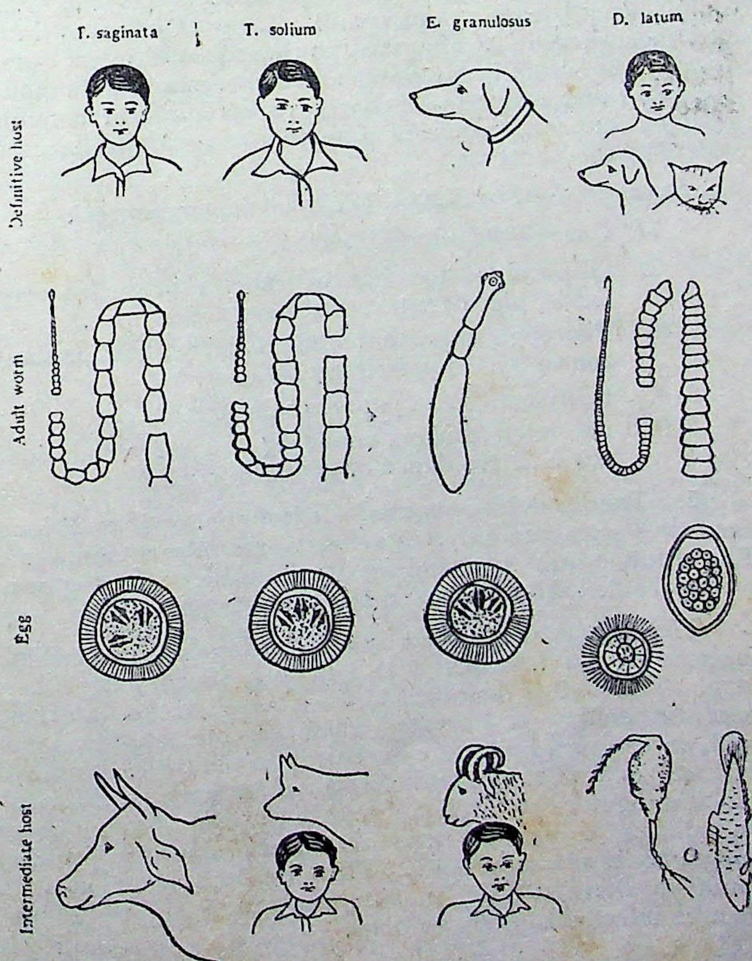


Fig. 63—Various tape worms.

3. Dibothriocephalus latus :—It is a large ribbon like tape worm 3 to 4 metres or 25–30 ft. long. The cysticercus inhabits some species of fish. The symptoms produced are not always severe. In some cases the blood produces the symptoms of pernicious anaemia. The eggs when discharged in the faeces of man develope in water into larvae and taken by a fish in water.

4. Hymenolepis nana or dwarf tape worm :—It is 5–45 mm. long and is very slender. Each proglottides contains 80–180 eggs which are set free in the intestines. It undergoes complete development from the egg to the adult stage without any intermediary host, the larval parasite enters the intestinal wall where it becomes cysticercoid. Later on it moves into the intestines where it attaches itself to the mucous membrane and develops. It occurs in hundreds and sometimes even in thousands and may cause symptoms of diarrhoea, epileptiform convulsions, headache etc., on account of absorption of toxins produced in the system by the parasites.

Prevention :—It consists of the following measures :—

1. Cure of the affected person.
2. Disposal of the human excreta in such a way that cattle, pigs or fish cannot have access to it.
3. Thorough inspection of meat and pork in the slaughter houses by the veterinary surgeon.
4. Thorough cooking of meat and fish.
5. Thorough smoking or salting of meat which is eaten raw and avoidance of taking raw meat.

5. Taenia echinococcus:—It is 4 mm. or ½″ to 2″ long and has 3 or 4 segments only. Its heads resembles taenia solium. The adult worm is found in the intestines of a dog or a wolf which are definitive hosts and has its cyst stage in man.

The ova are discharged by the dog in its faeces, which are ingested by the intermediary host, pig, sheep, oxen, horse or man. The shell is dissolved in the stomach of the intermediary host and embryo is liberated which on piercing the intestinal wall, encysts as a hydatid cyst, chiefly in the liver. This hydatid cyst attains a great size and forms within itself secondary cysts called daughter cysts. The liquid in the cyst does not coagulate on boiling. Under the microscope, characteristic head or detached hooklets can be seen. This disease is common in some countries where men live in close association with dogs and may then be infected directly by dogs.

Prevention :—(a) The stray dogs should be destroyed.
(b) Avoid the close association between dog and man

and contaminating the hands with the faeces of dogs. (c) Strict personal hygiene should be observed.

III. Trematodes or Flukes :—The common ones which infect human beings are :—

1. Distomum or Fasciola hepaticum (liver flukes) :— It effects sheep causing a disease known as "liver rot". It is 20 to 30 mm. long and 8 to 13 mm. broad—heart shaped.

The fertilised egg, when expelled from the bile duct into the sheep's intestine is passed out with faeces and becomes miracidium which if it encounters a fresh snail, enters its body where it is transformed into a tadpole-like "Cercaria". It passes out of the snail, sheds its tail and leaving the water moves up a grass blade where it encysts. When this grass is eaten by a sheep, the young fluke is set free in the intestines. It then finds its way to the bile duct, attaches itself to the duct wall and attains maturity. Very rarely man may become infected through drinking infected water.

2. Schistosoma or blood flukes :—Three species of these worms are known to occur in man. They are :—

(*a*) Schistosoma or bilharzia haematobium (urinary bladder).

(*b*) Schistosoma mansoni. The adults live in the veins of messenteries. The symptoms produced are dysenteric and in peculiar form of cirrhosis of liver. It is followed by a condition known as intestinal schistosomiasis.

(*c*) Schistosoma japonicum. It gives rise to oedema and ascites dysenteric symptoms, emaciation and in later stages cirrhosis of liver. The adult lives in the veins of the small intestines.

Schistosoma or Bilharzia haematobium :
The male ½″ long; the female ¾″. They are generally lodged in the veins of intestines, bladder, ureter or kidney. They give rise to a chronic disease characterised by cystitis, haematuria and other symptoms due to blockage of the urinary passages producing a papillomatous growth. They are common in Africa and Palestine. An

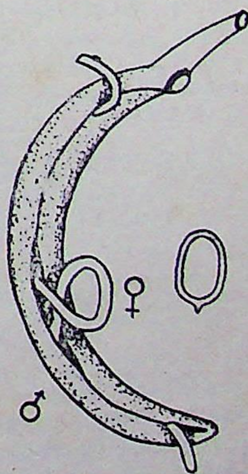


Fig. 64—Shistosoma haematobium (male and female)

endemic centre has recently been discovered in Ratnagiri in Bombay district. The males are narrow, flat and leaf-like worms and look cylindrical from the folding in the side of the skin, forming the gynaecophoric canal where the female is partially enclosed.

The eggs are oval or spindle shaped with a stout spine at the posterior end. These are forced through the walls of the vessel and eventually appear in the bladder or rectum and escape either through urine or the faeces as the case may be. They find their way into water, develop into a ciliated embryo or miracidium which becomes attached to its intermediate host *viz.* fresh water molluses and develops into a cercaria form. They infect man through the skin. They enter the veins where they gradually develop. They are able to pass through and therefore any one bathing or even putting an arm in water infected by these organisms may easily get infected.

Prevention :—Avoid drinking or bathing in schistosoma infected rivers or tanks. Boil water or strain through a muslin cloth to remove water snails. Copper sulphate solution in the strength of 1 in 5 million parts if used will kill the snails. Treat all the infected persons adequately. Prevent pollution of water with human faeces and urine.

Treatment :—Administration of antimony compounds is useful in the initial stages of the disease.

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CHAPTER XV

PREVENTABLE DISEASES

In the olden times the word disease used to denote "lack of ease" but gradually it has come in the modern world to mean some definite disorder or ailment in the human system *viz.*, body or mind or even both. Thus we speak of diseases affecting the body as a whole or any particular part or system of the body.

With the advance of civilization more and more diseases are coming into light and are being investigated and classified. Only a few important ones are discussed here keeping in view thelimitations of the book.

MALARIA

The word "Malaria" is derived from two Italian words mal (bad) and aria (air). This name was applied to the disease, because it was believed that the disease was due to inhalation of poisonous emanations from the ground, especially marshy places. This belief dates back since 1753. Malaria was known from the earliest times and was described by Hippocrates in 422 B. C. It caused the downfall of many empires, like of Greece. In India its havocs in the form of incalculable amount of suffering, loss of working power and individual and racial deterioration, are far more than any other preventable disease. No other disease in India causes in aggregate more sickness or greater loss of life than malaria and its social and economic effects are extremely deplorable. During the great malaria epidemic of 1903, it caused over 300,000 deaths. The havocs caused in India by malaria are.— 1. At least one hundred million persons suffer from malaria every year.

2. At least one million persons die every year from its direct effects. During years of its appearance in the form of widespread regional epidemic, this figure is greatly exceeded.

3. At least one million other people die annually from its indirect effects, rendering its victims easily susceptible to attacks by other diseases *e.g.*, tuberculosis, other respiratory diseases, etc.

Besides these havocs, other social implications of the disease are :—1. Illness of the wage-earner, especially in families under the marginal income groups, results in dislocation of the family of worker.

2. Lowering of vitality due to attacks of malaria leads the victim becoming an easy prey to many diseases such as tuberculosis, etc. This ends in loss to the nation as a whole.

3. Deaths caused by malaria amongst the age groups, which otherwise would have provided efficient labour for many years, result in total loss to the nation.

4. Lowering of vitality of industrial or agricultural workers due to attacks of malaria leads to inefficiency of the Indian labour and consequently sets back both the industrial and agricultural production.

5. It is well established that wherever malaria prevails and almost in direct proportion to its prevalence, the population is generally subnormal physically, mentally and economically.

Etiology :—The casual organism or the malarial parasite is a protozoa named Plasmodium of Malaria. It lives in the red blood corpuscles of the peripheral blood. Man acquires infection naturally only by the bite of an infected female anopheles mosquito.

The malarial parasites are of the following types :—1. *Plasmodium vivax* (Benign tertian parasite). It has a cycle of 48 hours causing fever after every two days.

2. *Plasmodium malariae* (Quartan parasite). It has a cycle of 72 hours causing fever, recurring after every three days.

3. *Plasmodium falciparum* (Malignant tertian). The fever is very irregular and may occur after every 48 hours. The symptoms are very severe and of malignant type *e.g.*, high fever, delerium and sometimes coma.

4. *Plasmodium ovale*, a parasite which produces a mild form of tertian malaria. This is found in Africa but is not found in India.

Developmental Cycles :—The life history of all the parasites is the same. The mosquito is definitive and man is the intermediate host. There are two cycles :—1. *Asexual or human cycle or Schizogony* :—When the infected female anopheline mosquito bites a healthy person and sucks the blood, she injects salivary fluid containing *sporozoites* in the circulation. Sporozoites enter the parenchymal cells of the liver and are called *cryptozoites* where they undergo developmental changes. During this period the patient does not show any symptoms or signs, nor any parasite in the blood-After the incubation period, which ranges from 10—14 days *preerythrocytic merozoites* are released, which enter the red blood cells of perepheral blood as *trophozoites* and give rise to clinical attack of malaria Each trophozoite assumes a round shape and continues to enlarge and pigment appears. After sometime chromatin begins to divide and then it is known as *Schizont* or a rosette body which divides into small bodies called *merozoites*. These, on breaking down of

blood corpuscles escape into blood plasma and enter fresh red blood corpuscles. This constitutes the asexual cycle and is called *Schizogony*. This may be continued indefinitely until checked by proper treatment.

2. *Sexual or Mosquito cycle or Sporogony* :—After a certain

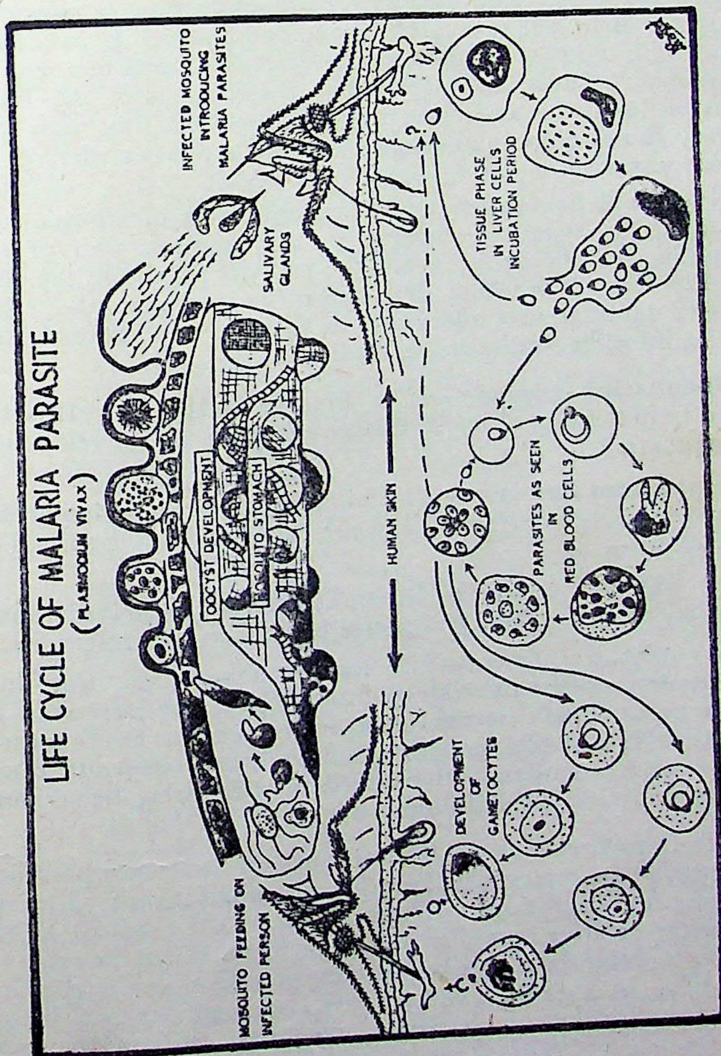


Fig. 65

number of asexual generations, some of the young trophozoites, instead of becoming schizonts, grow into male and female forms

called *gametocytes* in the red cells. They are incapable of further development unless they are taken by a female anopheles mosquito. In the stomach of the mosquito the male and the female forms escape from the red blood corspuscles and are known as *gametes*. One of the male gametes *micro gamete* impregnates a female gamete (*macrogamete*) and forms a body known as *ookinete* or *zygote*. which burrows itself into the stomach wall of anopheline mosquito and grows there, where a cyst is formed around it. It is called *oocyst*. This increases in the size and is packed with merozoites. The oocyst ruptures, discharging the *sporozoites* into the body cavity of the insects and ultimately they find their way into the salivary glands of mosquito from where they are transferred to a healthy person.

It takes 36 hours after the feeding on blood of an infected person, for the zygote to develop in the stomach wall of the mosquito. The Sporozoites reach the salivary glands on the 10th and 12th day. The whole development in the mosquito takes about 12 days and it is infective from the 12th day onward and remains infective for the rest of its life.

Incubation period :—It is from 14 to 18 days. It is the period from the bite of infected mosquitoes to the development of symptoms.

Important Factors :—The following are the most important factors which are interrelated and are concerned in the spread of the disease :—

(*i*) *Source of infection* :—Generally children or individuals with gametocytes in their perepheral blood, serve as reservoirs.

(*ii*) *Anopheline factor* :—The female anopheline transmits the infection under natural conditions from the reservoir to healthy persons and serves as a vector. There are breeding places for this type of anopheline. The disease depends upon their relative abundance, their feeding and resting behaviours and their individual suitability as a host.

(*iii*) *Climatic conditions* :—Certain temperatures and presence of humidity is necessary for the transmission of disease. The optimum conditions are a mean temperature of 20–30°C with a mean relative humidity of 63% or more. When the relative humidity is high the mosquitoes are more active and feed more voraciously. A high relative humidity also lengthens the life of the mosquito for the complete development of malarial parasite in it.

(*iv*) *Presence of susceptible individuals* :—The presence of susceptible persons such as labourers, troops etc., is also known as the factor of non-immune immigration.

(v) *Economic conditions* :—Insufficient food, overcrowding and famine conditions have a great bearing on the incidence of malaria.

(vi) *Irrigation* has affected the prevalence of malaria considerably. Leakage from canals or water logging of the soil of water pockets along the tributaries, due to improper maintenance lead to increase in the incidence of malaria.

(vii) *Malaria and rice cultivation* :—The land is to be flooded with water in rainy seasons for rice cultivation which leads to an increase of its incidence.

(viii) *Manmade malaria* :—Burrow-pits along roads and railway lines, tanks, water troughs, etc., provided by man serve as breeding places for mosquitoes.

Symptoms :—After an incubation period which averages 10 days, the attack begins with malaise, chilliness and severe rigor, which shows three well-marked stages :—

1. *The cold stage* :—The patient feels cold, listless, with headache, nausea and vomiting. He soon shivers and the teeth chatter inspite of abundance of bed clothes and hot water bottles. The skin temperature is subnormal although the rectal temperature rises rapidly.
2. *The hot stage* :—After one or two hours the patient begins to feel hot and the headache intensifies. The pulse is full and rapid. Cutaneous vessels dilate. Stupor, delirium and high fever may develop.
3. *The sweating stage* :—The skin being dry and hot rapidly becomes moist and there is a lot of perspiration. The temperature falls to normal rapidly and the patient feels comparatively well. It shows characteristic periodicity depending upon the particular parasite which is the cause of it. Anaemia and enlargement of spleen and liver are aftereffects of the disease.

Seasonal Incidence of Malaria :—Its maximum prevalence is from August to November.

Race :—Negroes are partially immune but no race is known to be completely immune.

Sex :—Males and females are equally susceptible.

Immunity in malaria :—There is no natural immunity. There is generally a partial immunity as a result of repeated infections and re-infections occurring over a long period.

Relapses in malaria :—After incomplete treatment the parasites disappear from peripheral blood, but lie dormant in the internal organs and after sudden weakening of the patient's resistance, as from chill, fatigue or other causes, such as reinfection from infected anopheline, relapses occur.

Malaria index :—It means the degree of prevalence of malaria in a locality or a district. It can be ascertained in the following ways :—*1. Statistical index or fever index* :—It indicates reports of medical practitioners and returns or statistics from hospitals and dispensaries regarding the cases and deaths from malaria.

2. *Splenic index* :—This term refers to the percentage of children who are suffering from enlarged spleen. Generally children under 10 years of age are examined for the following reasons :—(a) They are easily available for the purpose. (b) Adults may become partially immune.

If splenic index is less than 10% the locality is considered having low endemicity or healthy. If it is between 10 to 25% the locality is considered as moderately endemic. If it is between 25 to 50% the locality is considered as highly endemic. If it is above 50% the locality is considered as hyperendemic.

3. *Parasitic or endemic index* :—It represents the percentage of persons who harbour parasites. It is found out by conducting microscopical examination of blood films of persons, with a view to detect presence of malarial parasites.

4. *Sporozoite or anopheline index* :—It is calculated by determining the percentage of anopheline mosquitoes who show malarial parasites in their bodies after capturing and dissecting them. In a very malarious place this index may be from 5 to 10%.

Forecasting of malaria :—This depends upon the following factors :– (*a*) *Study of Meteorological conditions* :—The amount of rainfall during monsoon months extending over several years.

(*b*) *Economic condition* of the residents of the locality.

(*c*) *Spleen rate* of the community in different localities is ascertained every year.

Malaria Survey :—It is really a detailed social, sanitary and economic survey rather than exclusive malarial one. Before taking anti-malaria measures, it is essential to do a preliminary survey which consists of :– (*a*) Study of the territory, levels, slopes, meteorological conditions, soil and subsoil, the people and their mode of life, existing drainage and an estimate of the

cost of new drainage and also of the relation between the requirements of sanitation and agriculture.

(*b*) Mortality and morbidity statistics and malaria index in different localities, examination of spleen and blood of the inhabitants. Determine the species of malaria parasite.

(*c*) Discovery and registration of breeding places of adult mosquitoes, the species and their seasonal distribution. Investigation of their habits and their role in the production of malaria.

(*d*) Provision of a contour map of different places or districts showing marshes, canals, ravines and nature of vegetation, etc., is necessary. Information be obtained from the local gazetteer, the census and sanitary reports. It is also advisable to take photographs of breeding places of mosquitoes.

After the preliminary survey, proceed to :—(*i*) *Collect statistical information* : —From hospitals, dispensaries and schools, etc., Records of past surveys or years should be gone through.

(*ii*) *Ascertain the spleen index* :—In India different areas are classified according to spleen rate.

(*iii*) Prepare blood films of available children for ascertaining *parasitic or endemic index*.

(*iv*) Prepare a detailed spot map showing all the known *human carriers* in the area.

(*v*) Examine sample catches of all local anopheles. Find out the percentage of each anopheline species present, its chief breeding grounds and the time of year when most prevalent. Investigate the type of anopheles mosquitoes and their breeding places as to when and where they breed. Next start the dissection of mosquitoes caught in different areas and record the percentage infected with the following :—

(*a*) Oocyst in midgut.
(*b*) Sporozoites in the salivary glands of mosquitoes.

(*vi*) Correlate the information so obtained, so as to depict a clear picture of the amount, distribution and character of the disease especially the manner in which it arises and spreads in the locality.

It can thus be found out :—

(*a*) Whether malaria is old standing or recent in origin.
(*b*) What species of anopheles carriers are present with oocysts or sporozoite percentage.
(*c*) Reasons for sudden epidemic outbreak.

Formulation of preventive measures :—This will depend upon the conditions revealed by the results of the survey and

will be very largely determined by the financial resources available.

It is of great value, if a balance sheet is made out showing on one side the estimated sum lost annually from malaria by interference with labour, loss of wages and expenditure on treatment of sick and on the other the amount which is proposed to be spent on preventive measures. Business Firms such as controlling tea and rubber estates or engineering works are quick to see the force of such an argument, but it must be admitted that it is often difficult to persuade local authorities to spend money on antimalaria measures even when it is pointed out that such expenditure will be a sound financial investment, in the long run.

All the available statistical information regarding the prevalence of disease should be collected.

Methods of Prevention and Control :—They can be discussed under the following headings :—I. To do away with the conditions which render possible the breeding of mosquitoes.

II. Destroy mosquitoes at some period of life, *i.e.*, during adult and larva stage.

III. Prevent the mosquitoes from biting the man.

IV. Attack the parasite as it circulates in the blood of man. *i.e.*, adoption of anti-parasitic measures.

I. To do away with conditions which render possible the breeding of mosquitoes :—(*i*) To provide the drainage of the country on a large scale so as to drain properly the swamps and lakes. They should be narrow, and deep rather than broad and shallow. Sometimes subsoil drains are provided. They are more effective in dealing with hill streams. Their upkeep cost is high.

(*ii*) To provide drainage on a small scale around the town, so as to prevent rain water collecting in the pools, and in the compounds of houses. Try to fill all the depressions and small pools where water may collect.

(*iii*) To keep clean, straight and free from weeds the edges of canals and small water courses. This makes the water run quickly and by removing the weeds from the banks there remains no shelter or hiding place for the larvae.

(*iv*) To avoid having burrowpits along the roads, railway lines, tanks and pools where water can stagnate.

(*v*) To properly maintain irrigation channels and exercise proper control on the supply of canal water so that water is not supplied in excess of the actual requirements of the locality concerned.

II. To destroy mosquitoes at some period of life :—

(i) *Destruction of mosquito larvae or Antilarval measures :—* They are as follows :—(a) *Malariol, kerosene oil, diesel or fuel oil,* etc., is sprayed on the surface of water with a knapsack sprayer once a week or by soaking gunny bags, lump of tow or cotton waste in it and throwing them into water (2 ozs. or one chattack of kerosene oil for 30 sq. ft.). It asphyxiates the larvae as they cannot breathe. Vegetation in water should be removed to render it fully effective.

(b) *Paris green or Acetoarsenite of copper :*—It is mixed with 100 parts of fine road dust, slaked, lime soapstone, saw dust etc. and blown by a machine or manually. It is very toxic to anopheline larvae but it does not kill culicine and stegomya larvae. It is effective even in presence of dense vegetation. It does not kill fish or spoil water for domestic purposes. ½ to 1 lb. of paris green is used per acre.

(c) *D. D. T. (Dichloro diphenyl-trichloroethane)* is an efficient larvicide. It is effective even in very small quantities and thus there is a great saving if it is used for the purpose. It is used as 5 to 10% oily solution by spraying or 10% if used as a dust.

(d) *Larvicidal fish :*—These eat larvae of mosquitoes. There are many species of small fish in India. *Gambusia affinis* or top water minnows, etc., are used. They multiply rapidly and feed voraciously on larvae and pupae. They are surface feeders and so especially effective against anopheles larvae.

(e) *Gammexane W. D. P :*—To control mosquito breeding in wet crops like paddy fields, where use of malariol is contra-indicated on account of its charring effects on plants, gammexane has been found useful and economical. For stagnating water in such fields two ounces of gammexane W. D. P. mixed in a gallon of water is used at the rate of 15 gallons of the suspension per acre. It will destroy mosquito larvae but has no effect on eggs and pupae.

(f) *Observance of Dry Day :*—In cantonments, one day in a week is fixed when all cisterns, cess pits, stores of water, gharras, etc., are emptied and kept dry for some time and then refilled. In this way, if there is any breeding in these waters, it is destroyed. Similar 'Dry Days' should be observed in the rest of malarial places in the country.

(ii) *Destruction of adult mosquitoes :*—(1) D.D.T. or *Dichloro-Diphenyl-trichloroethane* a residual insecticide, is largely used in these days, in the form of emulsion or oily solution for spraying. After the evaporation of the solvent, minute crystals of insecticide remain on the surface of the walls. When

the mosquitoes rest on the wall, for 10-20 minutes, they absorb some of the D. D. T. through their legs and feet and get themselves poisoned and die. Generally emulsion of 5% strength is sprayed at such a rate that it will be sufficient to give protection for one mosquito breeding season. Dosage is 100 to 200 mgm. per square foot. It is used in the following forms :—

(*a*) *D. D. T. Aromax Emulsion* :—

D. D. T. Technical	110 lbs.
Aromax	36 gallons
Soap Lux flakes	8 lbs.
Water	32 lbs.

110 lbs. of D. D. T. is placed in a 45 gallons capacity barrel with an open top. Its lumps are thoroughly broken. About 4 gallons of aromax is then added to D. D. T. and thoroughly macerated to make a paste which is constantly stirred. Soap and water solution is prepared separately in a container. This is added to the D.D.T., aromax solution and mixed properly. The resultant mixture forms 25% D. D. T. concentrate and is diluted in the ratio of 1 in 10 with water to obtain 2·5% D.D.T. emulsion. It is sprayed with a stirrup pump or a knapsack sprayer, on the walls.

(*b*) *5% D. D.T. Kerosene oil solution* :—

D. D. T. Technical	8 Ozs
Kerosene oil (grade 3) one gallon.	

Add the required quantity into a container and stir thoroughly to make a solution of 5% D. D. T. kerosene oil solution.

(*c*) *Geigy's (50 % D.D.T. water wettable powder) suspension.*

Geigy's malaria spray powder	8 Ozs.
Water	1 gallon.

Make a paste of the Geigy's powder with a small amount of water and then add more water to obtain the suspension of requisite consistency.

(*d*) *Pyrethrum D.D.T. kerosene oil mixture or flit* :—

Pyrethrum extract liquid 4%	3 Ozs.
D.D.T. technical	1 Oz.
Kerosene oil	1 Gallon.

Dissolve D.D.T. in kerosene oil and then add pyrethrum ext. liquid. Spray it with a flit pump.

(*e*) *D.D.T. in aerosols* :—The aerosol bomb contains 0.4% of pyrethrins, 3% D.D.T., 5% cyclohexanone, 5% sesame or some other oil in Freon. Its pressure forces the combination into the room. It is widely used against mosquitoes and other insects.

(2) *Gammexane or benzene hexachloride or B.H.C.* :—

It is effective against mosquitoes as a residual spray, but its lasting properties are not quite so good. Gammexane P 520 contains 50% B.H.C. and is soluble in water forming a suspension.

Gammexane P 520 (water dispersible powder)	12 Ozs.
Water	1 Gallon

With a small amount of water, make a paste of gammexane and then add the balance of water to make milky suspension. It is sprayed by a pressure sprayer.

(3) *Dieldrin* :—This insecticide is newer than D.D.T. and B H.C. Like D.D.T. and unlike B.H.C. whole weight of dieldrin in a formulation is insecticidally active. It is said to be more effective against flies and mosquitoes than the other insecticides. Four ounces of dieldrin 50% water wettable powder is used in a gallon of water for surface spraying of 2000 sq. ft. to get the normal dose of 25 mg. per sq. ft.

(4) *Traps* of various types are available in the market. The mosquitoes are caught in the traps and subsequently killed.

(5) Cutting down of jungles and other useless vegetation, where the mosquitoes conceal during the day time, is of great value in a campaign launched against adult mosquitoes.

(6) Bats, birds, lizards and dragon flies are natural enemies of mosquitoes but they themselves are a nuisance.

(7) In olden days, different substances in the form of odours, fumes and gases were used but their use is now discarded since the discovery of D.D.T. Burning of katol sticks will also kill mosquitoes.

(8) Swatters consisting of a piece of wire gauze fixed to a wooden handle are effective and children may be taught to use them.

III. Protection against the bite of mosquitoes :—*1. Screening of buildings* :—Rendering the house mosquito-proof by providing non-corrosive wire-netting to the doors and windows of the rooms, which can be done by rich persons only.

2. *Mosquito net* :—One should sleep under a mosquito net, which is a most valuable preventive measure. The net should be of 25 hole mesh. It should be hung inside the poles and tucked properly with care under the mattress every night.

3. *Mosquito-proof clothes* :—Suitable clothings, boots, veils, gloves, etc., are used to prevent bite of mosquitoes.

4. *Repellents or culicifuges* :—Smearing various oils, ointments on various exposed parts of the body repel the mosquitoes by the smell *e.g.* Dimethylphthalate, citronella oil, eucalyptus oil, sandal wood oil, etc., which if applied to the skin, remains effective as a repellent for several hours. A common fomula is—

Kerosene oil	one part.
Cocoanut oil	two parts.
Citronella oil	one part.
Carbolic acid	one %.

Some patent fluids, *e.g.*, mosquitol, etc., are available in the market for the same purpose.

5. Fans, electric or ordinary, are the best means of driving away mosquitoes.

IV. Anti-parasitic measures : The antimalaria drugs are used for two purposes : 1. Prophylactic. 2. Curative.

1. Prophylactic :—There is no drug at present, which can be relied upon to prevent malaria infection, but the symptoms of the disease can be suppressed for some period. The drugs act by killing the parasites that have reached the stage, at which they can cause fever. The drugs used are :—

(*a*) **Quinine prophylaxis** :—It is used in the following ways :—

(*i*) 10-15 grains daily should be given on two successive days in a week. It is better that it may be taken in the evening so that it circulates at night in the blood when the anophelines are most active and inject sporozoites. Quinine acts powerfully in alkaline substrata. So a dose of sodium bicarbonate or any other alkali should be given by mouth before quinine administration. In case of benigns, tertian (P. vivax) infection, quinine has no effect.

(*ii*) 5-7 grains of quinine should be given daily as a prophylactic.

(*b*) **Mepacrine** :—(*i*) Many people prefer mepacrine to quinine. It is given in doses of 0.2 gramme twice a week. In

American army 0.1 gramme of it is given daily with evening meal for six days in a week.

(*ii*) *Suppressive treatment or blanket treatment* :—This is done with a view to reduce the occurrence of clinical attacks of malaria. This is done before entry into a malarial area or during transmission season under special circumstances. It does not prevent infection. This consists in administration of two tablets of mepacrine daily after taking meals and thereafter its use is continued by taking one tablet daily. The person should be under medical supervision and the treatment is to be continued for 28 days after withdrawal to a non-malarial locality or termination of a transmission season.

(*c*) **Paludrine** :—(*i*) A biweekly dose of 0.1 gramme or 0.3 gm. of it once a week is recommended for the inhabitants of the malarious area. For non-immunes, 0.1 gm. of paludrine daily is recommended.

It renders the crescents in human blood non-infective to mosquitoes, hence man ceases to be carrier of malaria infection.

2. **Curative** :—(*a*) *For acute single attack of malaria* :—Vivax malaria, malariae malaria and uncomplicated falciparum malaria respond to any one of the following courses of treatment. All act as schizonticidal drugs :—1. **Quinine** :—It is still the best specific, particularly quinine hydrochlor. Quinine sulphate is cheaper than other forms of quinine and so it is commonly used. There are three methods of administration of quinine which are as follows :—(*a*) Oral :—Quinine sulphate as acid mixture and quinine bihydrochlor as tablets ; 10 grains twice or thrice a day are given until temperature is normal for 24 hours followed by 10 grains daily for 7 days. With a week's interval between each such course, the liver should be kept normal with calomal and salts. Iron and arsenic should be prescribed during convalescence.

(*b*) Intravenous injections :—10 grains quinine bihydrochlor in 10 cc. of normal saline should be slowly injected when serious symptoms develop and may be repeated twice or thrice daily.

(*c*) Intramuscular injections :—10 grains of quinine bihydrochlor in 3 cc. of sterile saline are injected slowly and deeply into muscles of the buttock.

2. **Atebrine or mepacrine** :—Initial loading dose of 0.2 gm. if given three times daily for one day is essential, then 0.1 gram of it is given three times a day for 4 days. But it has the disadvantage that it causes yellow colouration of skin, gastro-intestinal disturbances and mental psychosis. It is however, safer for pregnant women than quinine.

3. **Combined treatment with quinine and mepacrine:—** To avoid complications and disadvantages, these days, treatment is begun with quinine for 3 days and then continued with mepacrine for 5 days.

4. **Chloroquine (also called Resochine or Aralen):—** A synthetic drug of amino quino-line derivative is three times more effective than mepacrine. 2 tablets of 0.5 gm. each should be given on the first day; whereas one tablet should be given on the 2nd and one on the 3rd day.

5. **Camaquine** :—0.2 gm. tablets are used. A single dose of three tablets constituting 0.6 gm. is given. It is as good as chloroquine in action. It can be used as mass therapy in rural areas.

6. **Paludrine or Proguanil** :—Its dose is 0.3 gramme twice a day for 3 days in vivax and malariae malaria but 0.3 gm. twice daily for seven days, in falciparum malaria. Its only disadvantage is that it causes gastrointestinal disturbances and does not prevent relapses which occur within 3 weeks.

(*b*) *For Relapsing malaria* :—The following combinations are used :—

1. *Quinine and Plasmoquine* :—

Quinine	10 grains
Plasmoquine	9 mgm.

Three times a day for 10 days.

2. *Paludrine and Plasmoquine* :—

Paludrine	0.1 gm.
Plasmoquine	9 mgm.

Three times a day for 10 days.

Plasmoquine is never used with mepacrine because it forms a toxic combination with it.

3. *Pamaquine or (Plasmoquine)* :—It is the best drug for malaria gametocyte carrier patients, because it is the only drug which acts on gametocytes of all forms. This is a synthetic proprietary drug. It is of little value in the treatment of most severe forms of malaria. It has very feeble action on dangerous asexual parasites of malignant tertian malaria. It is useful in treatment of carriers and for destroying all forms of quarten (P. malariae), benign, tertian parasite (P. vivax) and gametes or crescents of malignant tertian parasites (P. falciparum) in

perepheral blood. The dose is 0.1 gramme twice or thrice daily after food. It should never be given at the same time as atebrine. It may be given with quinine but the plan is to give it after the end of course of treatment with quinine or atebrine.

KALA AZAR

(Dum dum fever or Black fever)

It is an infectious disease characterised by irregular fever of chronic nature, enlargement of spleen and liver and presence of "*Leishman body*" (*Leishmania-donovani*) having been named after their discoverers Sir William Leishman and Donovan, in these organs. The patient is emaciated, anaemic, with black pigmentation of the skin, advanced emaciation of limbs, and chest with a bulging abdomen.

Etiology :—It is a parasite known as *Leishman Donovan body* (*Leishmania donovani*). It has a small round or oval body and is found in large mononuclears. The distribution and the parasites in the body is general but they are most numerous in the spleen, liver and bone marrow.

Prevalence :—In India it is prevalent in Assam, Bengal and Bihar.

Incubation period :—This is more than a fortnight.

Mode of transmission :—Its precise mode of spread is not yet fully known. It is believed to be transmitted to man by the bite of sand flies *i.e., phlebotomus Argentipes*. It is thus an insect borne disease.

Prevention :—

1. Early diagnosis and notification.
2. Isolation of sick.
3. Disinfection of discharges and houses.
4. Abolition of breeding places of sand flies.
5. Use of repellants furnishes temporary protection.
6. Destruction of sand flies with D.D.T. etc.

Treatment :—Antimony preparations such as sodium antimony tartarate 2% solution beginning with ½ gr. and increasing to gr. 2½ until grs. 31 have been injected and Urea Stibamin, a course of 10 injections is given intravenously twice a week.

YELLOW FEVER

It is an acute febrile disease characterised by toxic jaundice (yellowness of skin) and albuminuria and accompanied in the severest cases by haemorrhages from the stomach, nose and mouth.

Distribution :—It is a disease of tropical climates. It is absent in India. The disease is limited to certain parts of Africa, West Indies, South and Central America. It is endemic in West Africa and in latent form is found in places called "Silent Areas". "Jungle Yellow Fever" occurs in America due to infection from monkeys, which act as carriers.

Etiology :—It is an ultramicroscopic filterable virus which can pass through a Berkefeld filter. According to Noguchi the causative factor of the disease was a spirochaete called *Leptospira icteroides* but his view could not be substantiated.

Mode of spread :—The disease is spread through the bites of female *aedes aegypti* (Stegomyia fasciata) mosquito within first three days of illness. Hence the importance of early diagnosis and of preventing of patient from being bitten by mosquitoes especially during this period. The mosquitoes are not infective for 12 days after the bite, but after that period they remain infective throughout their life. These mosquitoes bite both during day as well as night.

Incubation period :—6 days.

Fatality rate :— It varies from 5 to 50% or even upto 80%.

Immunity :—Its recovery from one attack gives lifelong immunity.

Preventive measures :—1. Immediate notification.

2. Isolation of the case and the patient must be screened from the bite of mosquitoes for the first 4 to 5 days of illness.

3. *Measures against mosquitoes* :—They are :—

(*a*) Attack on their breeding places.

(*b*) Antilarval measures.

(*c*) Antiadult mosquito measures.

(*d*) Protection from bites of mosquitoes.

4. Disinfection of the houses by fumigation with formaldehade or sulphur.

5. *Protective Inoculation* :—(*a*) Inoculation with yellow fever vaccine, which consists of attenuated virus grown in chick embryo and dried in vacuum. It is issued in sealed ampoules and reconstituted with distilled water. The injection is not followed by any reaction. Immunity is established after tenth day and lasts for four years.

(*b*) Convalescent serum obtained from those who have recovered from yellow fever, has been tried. It gives some immunity.

6. *Quarantine* :— Non-immunised persons coming from endemic areas either in aircraft, ship or train are placed in quarantine of 9 days on arrival in a place where the disease is unknown but there is a possibility of developing, if once introduced. Office International d Hygiene Publique has recommended 6 days quarantine period for the disease but in order to minimize the risk of importing the disease from abroad, Government of India has increased this period upto 9 days.

7. **Measures against importation of yellow fever in India by aerial navigation** :—No aircraft shall enter India within nine days of leaving a region where yellow fever exists, unless a certificate is produced from Egyptian authorities to show that the aircraft has been properly disinfected and disinsecticided according to the schedule. No person may land in India by aircraft either as a passenger or a member of crew during the nine days following his departure from or landing in a similar region to the above mentioned, elsewhere than in antiamaryl aerodrome, unless he has been protected by vaccination which is considered efficatious or by a previous attack of the disease.

Treatment :—1. General febrile treatment. At the onset give a smart purge; phenacitin be given for backache. 2. Barley water and Dextrose, orange drinks should be taken freely, with Soda Bicarb. gr. 180 daily to keep urine alkaline. 3. Dextrose 5% in 10 ozs. of normal saline may also be given intravenously.

DENGUE

Dengue fever has a sudden onset with malaise skin rash, intense frontal headache, severe pains in the bones and joints. Temperature falls on about the fourth day and a slow convalescence begins. It is due to a filterable virus present in patient's blood. The disease is spread by the *Aedes Aegypti*. The virus is acquired by the mosquito by taking blood from a patient during the first 48 hours on the disease. It becomes infective in 12 days, after biting and remains life long carrier of the virus.

Prevention :—The method of prevention which depends

upon control of *Aedes Aegypti* are same as used against yellow fever.

SANDFLY FEVER

This is a 3 days fever, accompanied with headache, pyrexia, sharp articular and muscular pains and, occasionally, rash. The incubation period is 3-4 days. The disease is caused by a filterable virus which is present in the peripheral blood of the patient only during the first day of the illness. The vector is *Phlebotomus Papatasii* which must bite a patient of sandfly fever within first 36 hours. It becomes infective after 6 to 8 days and remains infective for more than a week.

Preventive measures :—They are :—1. Isolation of the sick. 2. Control of breeding of sandflies and their destruction. 3. Prevention of biting of sandflies, by anointing the skin with citronella oil etc.

Treatment :—is symptomatic. The patient should be in bed and salicylates given for relief of pain.

RELAPSING FEVERS

They are of two kinds—(*i*) Louse relapsing fever. (*ii*) Tick relapsing or Tick fever.

1. LOUSE RELAPSING FEVER

Definition :—It is an acute infectious disease characterised by an attack of high fever of sudden onset lasting for 2-5 days terminating in a crisis followed after an apyrexial period of 2-14 days and by a series of relapses each being milder in character than those preceding it. It has got a typical temperature chart.

Etiology :—The infection is due to a spirillum now called spirochaeta recurrentis or carteri (in India) which are generally found in peripheral blood during the attack of the fever but are absent in apyrexial stage.

Predisposing factors :—They are over-crowding, and insanitary conditions of life. Spread of disease is greatly enhanced when persons sleep closely huddled together, using common beddings and cots etc. Infestation may directly occur through clothes and use of common combs.

Mode of spread :—It is not communicable from man to man. It is carried from the sick to the healthy by blood sucking insects *i e*., body-lice and possibly bugs. When a louse bites an infected person, it swallows the spirochaetes, which at first disappear, but a week later will be found in large numbers in the body fluid of the louse. When this infected louse bites another

healthy person, he feels irritation and scratches with finger nails the place where the louse has bitten and in doing so crushes the louse incidentally and infection is thus transmitted through the skin. The spirochaetes enter the body through the abrasions caused by scratching. Thus the note-worthy point is that the louse itself does not inject the spirochaetes into the human skin as is sometimes wrongly supposed. Both sexes bite and convey the infection.

Incubation period is from 5 to 10 days.

Mortality :—10 to 50%.

Seasonal prevalence :—The disease is most prevalent in cold season and early part of hot weather. In famine and war this disease generally spreads and so it is sometimes called Famine Fever.

Class of people affected :—In rural area, poor classes are generally affected while in towns it has so far been confined to sweepers, shoe makers, coolies, etc. So the disease is mainly due to poverty and uncleanliness.

Preventive measures :—These are as follows :—

(*i*) Early diagnosis and notification of the disease.

(*ii*) Isolation of the patient in an isolation hospital or at home.

(*iii*) Destruction of lice :—Disinfestation of the clothing, bedding, cots, etc., of the patients and contacts by 5-10% D.D.T. powder (mixed with talcum powder). This should be freely rubbed in head and dusted in clothings, beddings, cots etc., by means of a dust gun. The use of D.D.T. for this purpose has proved most efficatious. The persons engaged in control operations and those attending on sick persons wear louse-proof clothing dusted with D.D.T. powder. When D.D.T. powder is used for elimination of head lice no oil should be used on the hair because it is extremely dangerous to use D.D.T. in kerosene oil or any other greasy ointment, since in that case it is absorbed rapidly through the skin with harmful effects. In head lice, 3 applications of D.D.T. at weekly intervals should be made.

Before the discovery of D.D T. the following measures were carried out :—(*i*) In war, Serbian barrel was much used for disinfestation and disinfection of clothes. It undoubtedly killed lice but failed to destroy nits so double process was used *i.e.*, killing lice by steam and nits by ironing. Sometimes the clothes began to emit bad smell. There was also difficulty in transporting Serbian barrel from place to place, as it is heavy.

(*ii*) Boiling clothes in solution of soap and crude potassium hydrate or *Sajji* for half an hour in an empty kerosene oil tin, particularly in villages.

Other methods of destruction of lice are :—(*i*) Hand picking and combing the head with a moderately heated comb through the hair or one dipped in vinegar. Where possible cut short or shave the hair of the head.

(*ii*) Hand picking of the lice from the infected clothing and turning their inside seams and folds outwards. Do not crush lice in between the finger nails but kill them by drowning in water or putting in fire.

(*iii*) Exposure of clothes to sun with frequent turning and dusting with a stick.

(*iv*) Valueless clothes should be burnt and others disinfected. Heavy clothes as quilts etc., should be put in the sun and then ironed in between the seams and folds.

(*v*) Cots should also be treated with boiling water followed by soaking with phenyl and exposing them to sun throughout the day.

(*vi*) For killing lice, bugs, etc., in infected rooms :—Fumigation with cresol is sometimes done.

(*vii*) Pediculicides :—1. N.C.I. powder :—

Naphthalene	96 parts
Creosote	2 parts
Iodoform	2 parts

2. An emulsion :—

Kerosene oil Mustard oil Soap	equal parts
Camphor	litle of it

(*viii*) Great attention should be paid to the regular change of underwears.

(*ix*) Improvement of living conditions with provision for frequent bathing and washing of clothes.

(*x*) Specific treatment :—Penicillin G in adequate doses.

Arsenic therapy is also widely used. A single intravenous injection of 0.4 G Neoars-phenamine for an adult and 0.1 G for a child usually prevents relapses.

2. TICK RELAPSING FEVER

It is caused by *spirochaeta duttoni* which is transmitted by various species of ticks from infected persons to healthy ones. It is not communicable from man to man. The disease is non-existent in India but is found in Kashmir and North Western parts of Pakistan. It is wide-spread throughout tropical Africa.

The disease is difficult to control on account of difficulty in

destroying all the ticks particularly those hiding in the burrows of rodents.

As a preventive measure one should avoid the bite of the ticks by not going in the houses or places infected with ticks. D.D.T. or gammexane powder should be freely dusted on the floors and other hiding places of the ticks. If a tick is noticed attached to the skin, it should be promptly removed by applying a drop of kerosene or turpentine oil to its body.

TYPHUS FEVERS

Four types of fevers are generally grouped together and called the typhus fevers, which are as follows :—

(*i*) Louse typhus also called Epidemic Typhus or Exanithematic Typhus.

(*ii*) Flea typhus or murine typhus.

(*iii*) Tick typhus or tick borne with several varieties like tick bite fever, rocky mountain, spotted fever etc.

(*iv*) Mite typhus or mite borne typhus.

EPIDEMIC TYPHUS

(Spotted fever, jail, camp or ship fever.)

Symptoms :—Onset is sudden with headache, vomiting, high temperature and delirium. The eyes become pink and watery. A characteristic rash appears about the fifth day firstly in the axilla, on the loins, abdomen and back which frequently becomes petechial. The disease terminates by crisis or rapid lysis. In fatal cases death occurs on the 14th day.

Mode of spread :—The infective agent is *Rickettsia Prowazeki* which are oval filter passer organisms. A pediculus humanus (rarely pediculus capitus) bites an infected person, with febrile disease and takes instrinsic period of 10 days before it becomes infective for another human being It excretes rickettsia in its faeces and usually defecates at the time of feeding. Man is infected by rubbing faeces or crushed lice into the wound made by the bite or superficial abrasion of the skin.

Diagnosis :—

1. Weil Felix Reaction is carried out. It is agglutination of Bacillus Proteus X 19 by the patient's blood serum. It is of diagnostic value at a titre of 1 in 100 upwards.
2. Positive diazo-reaction of the urine of the patients.

Season :—It is mainly a disease of temperate climates and occurs in winter.

Fatality :—On an average it is 15% to 30% in children and up to 60% in grown ups.

Prevalence :—It occurs in most colder areas of the world where appreciable group of the people live under unhygienic conditions and are lousy. It is mostly found in Punjab, N.W. Frontier Province. Pakistan and Kashmir particularly at the end of winter.

Preventive measures :—

1. Notification.
2. Isolation :—Patient should be stripped of all clothings before being admitted to the isolation hospital and should receive a bath and have all body hair shaved. He should be thoroughly dusted with 5% D.D.T. powder.
3. Delousing of patient and delousing or destruction by fire of his clothings.
4. Disinfestation of the infested house :—By fumigation with hydrocyanic acid gas, if it is not possible to disinfest the house with sulphur dioxide or D.D.T. emulsion.
5. Clothing :—These are disinfested and disinfected with steam, D.D.T. powder *i.e.,* 5 to 10% D.D.T. with French chalk or talcum powder, is sprayed or dusted in clothing.
6. Prophylactic vaccine :—It is prepared from lice and used for the protection of workers.
7. Medical and nursing attendants should wear louse-proof suits and vigorous inspection for presence of lice should be carried out.
8. Improvement of living conditions with provision for frequent bathing and washing of clothes.

Treatment :—The patient is isolated in bed, deloused by D.D.T. powder, the head closely clipped and disinfected and axillary and pubic hair removed. Treatment is symptomatic by sedatives and cardiac stimulants. Newer antibiotics as chloromycetin, aureomycetin and terramycin have given good results.

PLAGUE

Definition :—Plague is an acute infectious disease characterised by high fever, inflammation of lymphatic glands, forming buboes and sometimes by pneumonia or septicaemia. The onset is sudden. The patient is obviously severely toxic with rapid irregular pulse, marked headache, tremor, restlessness, unsteady gait, mental confusion, prostration, delirium, coma etc.

Cause :—The specific cause of the disease is Pasteurella pestis or bacillus pestis. It is present in large numbers in the buboes of all cases of bubonic plague, in sputum, of pneumonic cases and blood of septicaemic cases. It is also present in the spleen, intestines, lungs, kidneys, liver, other viscera, and in blood in small numbers.

Incubation period :—3-5 days, shorter in Pneumonic plague.

Varieties of plague :—

1. Bubonic plague :—It is most common. The lymph glands draining the site of original inoculation are enlarged which develop on about 3rd day. The buboes are tender and the surrounding tissue is swollen from oedema. Suppuration is common. Bacilli are obtained by puncture of glands.
2. Pneumonic plague :—It is conveyed by droplet infection and not by rat flea. Sputum contains large number of bacillus pestis. The constitutional derangement is out of all proportion to any physical signs in the chest. Delirium is common. The case mortality is 98 to 100 per cent.
3. Septicaemic plague :—It is proved by blood smear or blood culture. It is invariably fatal.

Mortality :—In untreated Bubonic Plague 25 to 50% ; Primary septicaemic and pneumonic plague are usually fatal. Modern therapy has materially reduced the fatality.

Epidemiology :—There are two groups :—

(*a*) Urban or domestic form occurring in densely populated localities. It spreads along trade routes and is transmitted from rats.

(*b*) Selvatic or rural plague :—It is characterised by sporadic cases scattered over extensive country area through epizootic infection of a number of animals.

Seasonal Prevalence :—It shows a well/mark seasonal prevalence. Its intensity being at its lowest ebb in July, gradually increasing till it reaches its zenith in March and declining during next four months. High saturation deficiencies, accompanied by high temperature, causes reduction in the incidence of plague.

Role or the part played by rats :—Plague is really an epizootic in rats and to a less extent in other animals like guinea pigs, but under certain circumstances it attacks human beings. There are two varieties of rats :—

1. Black domestic rat or *Rattus Rattus* is a comparatively

small animal. Its tail is longer than the body. It has a small pointed head, a smooth coat and large ears. It lives in close association with man and does not migrate to any distance. It is most susceptible to plague.

2. Brown rat or *Rattus Norvegicus* or *Mus Decumanus* is a wild rat and is comparatively large. It stail is shorter than the body. It lives in sewers and drains.

The rat plague is disseminated primarily by the brown sewer rat, to black domestic rat or *rattus rattus*. The epizootic among rats is followed after about a fortnight by the outbreak of human plague.

Role of fleas in plague :—Yersin was first to discover that fleas play a great part in transmission of plague. The Indian plague commission carried out several experiments in 1901 and 1902. These clearly proved that if fleas were excluded, the healthy rats will not contract plague even if kept in contact with infected rats. If the fleas are introduced during the experiment, the plague at once begins to spread from rat to rat. So these prove conclusively that the most important agents in development and perpetuation of epidemic are the rat fleas.

Flea Index :—This is the number of fleas found on a rodent. The average flea index is 5.5. The flea index is highest during later part of winter and lowest in the monsoon months.

Mode of spread:—It is primarily a disease of rats. The house rat or *rattus rattus* gets infection from sewer rat or *mus decumanus* during epizootic season. As the disease breaks out in rats, healthy rats run away leaving the infected ones. Ordinarily the rat fleas do not attack human beings, but rats begin to die, the fleas for want of their natural host begin to feed on man and infest him either by regurgitating the plague bacilli which are in their stomach and oesophagus or by excreting with the faeces and thus infecting man through scratching or through bite, wound, or a minute existing abrasion of the skin. If regularly fed on blood, the rat flea may remain infected for about three weeks. In hot, dry climates, the flea soon dies. The epizootic in rats is a precursor to the outbreak of human plague. The bacilli find their way to the nearest glands where they are held up. The glands get inflamed and swollen and form a bubo in groins, axilla, etc.

Pneumonic plague spreads from man to man directly through the inhalation of throat secretions from the patient and the fomites. It is very highly infectious. Rat fleas play no part in spread of this infection which is fortunately rare.

If it happens to puncture a vein instead of skin, the bacilli are introduced into the blood and septicaemic plague results.

Extension of plague epidemic :—It follows trade routes, spreads from house to house, street to street, village to village and from one province to another depending upon the emigration of infected rats, but mostly rat fleas spread by incidentally getting carried in the beddings to far off places. These fleas are imported on the body or in the beddings of the people. These fleas start the disease first in rats and then in men and in this way the roll goes on.

Blocked flea :—*Xenopsylla Cheopis* ingests the infected blood on biting. The proventriculus of the flea gets blocked with mass of bacillus pestis growing on the ingested blood. This flea is called blocked flea. It cannot fill the midgut with blood and therefore it is in a starved condition. When it makes efforts to suck more blood it causes injection of bacilli into the skin of the host.

Partially blocked flea :—When the flea is feeding, it not only draws blood from the wound made by the mouth parts but also draws forward the contents of mid-gut; the regurgitated blood from the mid-gut mixing with the blood in the oesophagus may then readily infect wound with plague bacilli. It is a serious danger to the community. It lives longer as it is able to ingest small quantities of blood as compared to a completely blocked flea.

Prevention and Control :—The preventive measures are as follows:—

1. *Notification* :—Prompt notification be enforced of the incidence of plague cases as well as of the abnormal mortality among rats.

2. *Isolation* of the person suffering from plague into an infectious diseases' hospital, if practicable or in any segregated room of a house particularly in case of pneumonic plague.

3. *Evacuation of the infected premises* :—As soon as the disease is recognised, the inmates of infected houses are removed to segregation camps and huts. This step should be taken when there is abnormal rat mortality in a house. Subsequent arrangements be made for the disinfection of the house and destruction of rats and fleas.

4. *Prophylactic antiplague inoculation* :—Haffkine's Anti-plague Vaccine :—Dose is 2 cc. generally when given in a single dose, or 1 cc. followed by another 1 cc. after a week. There is severe local and general reaction. It confers immunity for 6—8 months. Prophylactic Inoculation with avirulent living plague bacillus by de Vogel and Otten is much favoured in Java and Madagascar.

5. *Campaign against rats* :—(*a*) The construction of rat proof houses :—The grain stores and grain markets should be

situated away from the residential area and should never be utilised for the purpose of human habitation. The houses and grain stores should be rat free. In the houses no water or food be exposed where rats can have access, so they will run away for want of food.

(*b*) Rat destruction :—The public should be educated that the rats are their greatest enemies and they should be destroyed at all cost. It is objectionable with certain communities such as Jains. The methods employed are as follows : (*i*) *By poisonous baits* :—Baits consist of an innert base to which is added some poison. The common bases used are atta, bread mash, sugar meal etc. The most common poison used is barium carbonate. It is cheap, tasteless and safe to handle. 1 lb. of barium carbonate and 2 lbs. of atta or flour are thoroughly mixed with water and made into a fairly firm mass. Divide the mass into 2400 round baits of uniform size so that each should weigh 9 grains and contain approximately 3 grains of barium carbonate. While preparing these it is very important to avoid imparting them any extraneous taste and odour such as from dirty hands and utensils; for rats have highly developed and delicate sense of taste and smell. These are placed 20 to 40 in each house in places only accessible to rats, behind boxes, and beneath cornbins so that danger of their being taken by domestic animals and children is eliminated. A single baiting is all that is required and baiting over successive days has no advantage. Prebaiting has proved to produce far better and constant results than direct poisoning. The method is to lay unpoisoned prebaits on the first and third day and similar baits containing poison on the fifth day. The one great disadvantage of this method is that these operations are sometimes followed by an offensive smell in some of the houses due to decomposition of dead rats in places from where they cannot be removed. This can be usually prevented by closing the rat holes with mud to entomb them.

The other common poisons used for this purpose are strychnine, white arsenic, phosphorus, zinc phosphide and red squill. Recently highly effective rhodenticides as sodium fluoroacetate (1080) and dicoumarine (Warfrin) have come into the market. Trained personnel should be engaged to distribute them.

(*ii*) *By Fumigation* :—This is a very effective method. It should be carried out by a trained squad. All openings of the burrows except one should be closed. The nozzle of the pump is introduced into the burrow and fumigation is done. Consequently all the rats along with their fleas are killed. Cyanogas "A" dust or cymag is blown by Cyanogas apparatus which is

very commonly used and is very effective.

The other gases which are used are carbon monoxide, carbon dioxide, sulphur dioxide, etc. An ideal fumigant should be toxic to rats and fleas. It should have a great penetrative power and must be non-combustible and non-explosive. It should be easily available in the market and should preferably be fairly cheap.

(*iii*) *By trapping* :—There is a great advantage of killing rats by trapping over baiting in that it can be carried out as a more or less permanent measure. It is relatively expensive and requires good supervision. To be effective it should be carried out continuously with sufficient energy to ensure that more rats are removed than replenished by breeding. The traps are placed in adjoining houses for 20 to 30 days and then removed to the next block. Trapped rats are transferred every day to the collecting cage, which is taken to the disposal station where the rats are drowned by immersing the whole cage in a tub containing water and phenyl or other suitable disinfectant or pulicide. Traps should be cleansed with boiling water and smeared with sweet oil once a week to keep clean and attract the rats and prevent their rusting. Attention must be paid in varying the baits. Stale and useless vegetables and fruits are good. Onions, rice, chapaties, meat and melons are excellent baits.

6. *Destruction or extermination of rat fleas* :—This is a most important measure adopted in these days for the prevention of plague. D.D.T. or gammexane are the chief residual insecticides used for the destruction of rat fleas. The floors are dusted with 10% D.D.T. powder and the walls are sprayed with 5% D.D.T. emulsion in kerosene oil. Similarly gammexane dust 8 ozs. for every 100 sq. ft may be used. Since fleas are found in cracks and crevices, so that floors and walls upto 4 ft. should be specially attended to.

The standard kerosene oil and soap emulsion or pyrethrum extract in kerosene oil in the ratio of 1 in 20 may be used as a spray. Naphthalene may be sprinkled on floor. Cresol fumigation in bubonic plague and formaldehyde gas fumigation in pneumonic plague are also carried out.

In clothing and bedding, the fleas are killed by means of exposing them to sun's rays. It has experimentally been shown that a temperature of 116°F for 45 minutes will kill fleas in clothings and quilts. For practical purposes, clothes should be subjected to a temperature of 120°F for at least one hour :—

(1) The piece of ground selected for exposure should be flat and hard, preferably with a layer of sand and should be free from grass, leaves, stones, etc., which might afford shelter to fleas.

(2) The clothes should be thinly spread in a single layer

and thick clothings should be turned over once or twice. 3. Exposure to full sunshine during the hottest part of the day should be continued for one hour.

7. *Disinfection* of room with D.D.T. or gammexane emulsion should be done in bubonic plague. Spraying with pestrine or kerosene oil or napthalene and cresol fumigations are also carried out. In pneumonic plague, fumigation with formaldehyde should be done.

8. *Personal Protection* of field workers against fleas by weekly dusting of clothing with insecticide powder. Daily application of insect repellents is a valuable adjunct. In presence of pneumonic or suspected pneumonic plague physicians, nurses and attendants must be protected by complete overalls, gloves, and hoods equipped with face masks of three tailed bundage with a pad of cotton wool. This face mask should be burnt after each exposure to infection.

9. Education should be imparted to lay public by means of lectures, hand bills, films and slides to show how infection occurs and to teach them how to guard against rats and fleas.

10. *Maritime Quarantine* :—(1) All non-infected ships coming from foreign ports should possess a six monthly certificate of deratisation. If they do not possess a certificate to the effect they will be inspected and if rats are found, they will be fumigated.

(2) Any ship coming from foreign ports which within preceding 60 days, touched a foreign port in which human or rat plague has been notified, will be treated as rat infested ship. It must get deratisation certificate. The ship will be kept far away from the quay and gangway removed until the needful has been done.

Treatment :—Streptomycin is the drug of choice for the treatment of all forms of plague. It should be administered intramuscularly in the following doses:—0·5 gm. every 3 or 4 hours is given until the temperature becomes normal, thereafter 1 gm. of the medicine is given daily in divided doses until a total of 15·0 gms. has been given. In severe cases, auremycetin, terramycin or chloromycetin should be used in addition to streptomycin.

Sulphadiazine and sulfamerazine are also recommended for use in large outbreaks of the disease.

Surgical treatment of bubo :—Hot wet applications may hasten localisation. Incision should be avoided till frank fluctuation occurs.

ENTERIC FEVERS

Enteric Fevers include typhoid and paratyphoids. The former is caused by Bacillus typhosus and the latter by Bacillus paratyphoid A. B or C. These are acute infectious and highly communicable fevers of long duration found all over the world affecting middle age group, more in males, than in females and have got an incubation period of 10-14 days.

Symptoms :—Onset is insideous. The patient complains of severe frontal headache and backache. Slow fever starts which goes on rising by about one degree every day. Tongue is dry and coated. Pulse is slow in comparison to temperature. If not treated it sinks into typhoid state. The diagnosis is confirmed by :—(1) Blood culture (2) Widal reaction

Typhoid and paratyphoid bacilli are found in blood, during first two weeks and in urine and faeces of the patient after two weeks and also in faeces and urine of the carriers. Bacilli remain alive in faeces and water for a considerable period, when not exposed to sunlight, but do not multiply in them. They multiply in milk. They are destroyed by heat at 60°C. They are killed by phenyl 2.5%. They may live for many weeks in ice. In the upper layers of the soil it retains its vitality for a long time.

Mode of spread :—The disease is chiefly spread by the discharges from the bowel and urine through the medium of water, milk, articles of food and drink and also through the agencies of flies, fomites and dust. Typhoid carriers are one of the important causes of spread of the disease, of which the faecal carriers are more common than the urinary ones. Carriers are more common among persons over 40 years of age, especially females.

The infection enters through mouth and reaches intestines where the organisms attack the lymphoid follicles (Payer's patches) and enter the systematic circulation and so the bacilli are found in it in the first week. Later on the bacilli are discharged in the faeces and urine.

The infection may be direct or indirect. The former is due to lack of observance of proper precautions in handling patients and their discharges. The latter is through contaminated articles of food and drink as in water, milk, vegetables, oyster, shell fish etc., Soil plays an important part in the spread of the disease.

Age :—It is common between the age of 5 and 35 but uncommon under 5 years.

Seasonal Prevalence :—It is prevalent through out the year, common in warm weather and maximum in July to October.

Occupations :—The classes of people who are more exposed to infection *i.e.*, doctors, nurses etc.

Social status :—It affects both rich and poor and strong and weak alike.

Morbidity :—The incidence increases in young adults and decreases with age.

Case Mortality :—Higher during adolescence; increases with age.

Case fatality rate :—Varies from 5—20% in typhoid; 2.5 to 3.5% in paratyphoids.

Immunity :—All who are exposed to the disease are not affected. After one attack there is solid and lasting immunity. Second attack also occurs but such cases are few.

Prevention :—The following measures should be adopted :—

1. Compulsory notification of a case of typhoid fever to the health authority of that place.

2. Isolation :—The patient should be isolated in a fly-proof room. Hospital care is desirable for patients who cannot command adequate sanitary environment and nursing care at home.

3. Arrange for the thorough concurrent disinfection. The stools, urine and sputum are received in a vessel containing some strong disinfectant and allowed to stand for 1 to 3 hours, say carbolic acid 1 in 10 or izal 5%. Afterwards it is burnt or buried. Soiled clothes, bedding, etc., should be soaked for one hour in 2.5% cresol or phenyl solution and then disinfected with steam. Utensils of the patient should be boiled. The attendants should dip their hands in some strong disinfectant solution. Rooms and gutters should be sprayed with carbolic or phenyl lotion.

4. *Prophylactic inoculation* :—T.A.B. inoculation is done in two doses. An initial dose of 0.5 c. c. and subsequent dose comprising 1 c.c. is given after a week or ten days. It gives immunity for six months. There is some general reaction consisting of mild fever, headache and general aching. There may be a slight local reaction also.

5. General sanitary precautions :—These consist of :—
   (*a*) Efficient conservancy arrangements, leaving no refuse for breeding of flies.
   (*b*) Good, pure and safe water-supply.
   (*c*) Pure and wholesome supply of milk and milk products. Only boiled and pasteurized milk should be taken.

(*d*) Proper supervision of articles of food and places where they are manufactured and offered for sale. They should be protected from dust and flies. The milk should be boiled or pasteurised.

(*e*) Adoption of adequate antifly measures.

(*f*) Discovery and proper control of carriers. Training of convalescents, and chronic carriers in personnal hygiene, articularly as to sanitary disposal of excreta, thorough hand washing after defecation and before eating and exclusion from acting as food handlers.

6. Education of the public by leaflets, posters, filmstrips and cinema slides, particularly on the role of 5 Fs *viz.*, Fingers, Food, Flies, Faeces and Fomites.

Treatment :—Patient should be kept in bed, lying flat and turned to sides at times to prevent bed sores. Good nursing is needed. Orange juice and whey should be given every 4 hours. Chloromycetin is the specific drug to be given by mouth in doses of one gram every six hourly for 2 to 3 days until the temperature comes down and then 250 mgm. is given eight hourly for 3-4 weeks.

Complications are dangerous and should be properly treated. A starch and opium enema may be required for diarrhoea or for haemorrhage. Laparotomy is essential in the event of perforation.

CHOLERA

Cholera is an acute infectious disease, caused by specific infection of alimentary canal, characterised by sudden onset of severe watery diarrhoea, vomiting, cramps in legs, great thirst and suppression of urine. The stools are like rice water.

It is endemic in East Pakistan, the delta of Ganges and some other parts of India. Epidemic-extensions take place from time to time. The infection is imported from these centres by rail or road, by means of persons suffering from it and by carriers, infected articles etc.

Season :—It occurs in late summer and autumn and generally dies away with the appearance of cold weather. Warmth and moisture are important predisposing factors for the prevalence of the disease.

Etiology :—It is caused by a living germ called *cholera vibrio*, which is found in the stools and vomits of the patient. It is active, mobile, coma shaped and gram negative organism. It grows in an alkaline medium at a temperature of 30°C to 40°C. It dies at 55°C in 15 minutes. In fresh water it cannot survive

long. It grows outside the body in soil, polluted with organic matter, sewage, milk and other articles of food and drink. Insects, particularly the house fly plays an important part in dissemination of this disease. The germs of this disease can live for a fortnight in a fly.

Mode of spread :—1. By mouth :—When polluted water, infected milk or food are taken.

2. From person to person :—Carelessness of persons attending on the cholera patient by not washing their hands properly, and thus infecting the food or drink or themselves.

3. Fomites :—From clothes and linen soiled with discharges of infected persons.

4. Indirectly :—Through flies which carry infection both mechanically and vitally.

5. Cholera carriers :—These are not a significant factor in spread of infection.

Incubation period :—This is very short, ranging from a few hours to 1 or 2 days but occasionally prolonged upto 10 days.

Immunity :—One attack confers a mild grade of immunity which appears to afford some protection for several years.

The evacuations of a cholera case are most infectious during the height of the disease. In the epidemic period the proportion of deaths to the attack is greatest during the period of maximum intensity of the epidemic. When it begins to subside, the recovery rate may considerably exceed the number of deaths.

Preventive measures :—They are as follows :—

1. *Notification* :—The case should be notified promptly even if it is a doubtful one.

2. Isolation of case in an isolation hospital or at home. The contacts should be segregated and treated.

3. *Local measures* :—(*a*) All dejecta should be received in a basin in which there should be placed quicklime at the bottom. It should be buried or burnt away at a great distance from the town.

(*b*) Lime should be sprinkled on the floor of the room in which the patient is being treated.

(*c*) Antifly measures should be taken. Fly papers be placed in the room.

(*d*) Disinfection of soiled linen should be done before it is sent for washing.

(*e*) Some suitable disinfectant be kept at the door for washing hands after attending and nursing the patient.

(*f*) Protection of articles of food and drink from flies and dust. 5 Fs. are dangerous :—"Fingers, Food, Flies, Faeces and Fomites".

(*g*) All latrines, privies drains etc., should be cleaned with a disinfectant lotion or sprinkled with lime or bleaching powder.

4. Anticholera or essential oil mixture :—This is used both for preventive and curative purposes. Its formula is :—

R/		
	Spirit Aetheris	30 mins.
	Oil of Cloves	5 mins. each
	Oil of Juniper	
	Oil of Cajuput	
	Acid Sulphuric aromatic	15 mins.

Dose :—1 drachm in an ounce of water taken every half an hour. Total daily average dose is 8 to 10 drachms for curative purposes. For treatment of contacts for the first five days till immunity is acquired after anticholera inoculation, one drachm of the mixture is given in water once or twice daily.

5. (*a*) *Anticholera inoculation* :—An initial dose of 0.5 c.c. and a subsequent dose of 1 c.c. of anticholera vaccine should be injected after an interval of one week or 1 c. c. of the vaccine may be injected straightaway in a single dose in mass inoculation. It contains 8000 million vibrio cholera per c.c. It confers immunity for six months. In the case of epidemics a booster of 1 c.c. should be given every six months. Many countries require travellers from an endemic cholera area to possess an international cholera vaccination certificate for entry, which is valid from 6 days after injection for 6 months. There is a mild local and general reaction.

(*b*) *Bilivaccine* :—One pill of vegetable bile salts is taken empty stomach, followed by one tablet of vaccine consisting of 60 billions of dead bacteria, after 15 minutes. This is repeated for 3 days. Immunity lasts for a year.

6. *Disinfection* :—Both concurrent and terminal disinfection should be carried out. Beddings and clothings should be disinfected by steam. If this cannot be done effectively, burning is the most important measure after getting the permission of the owner. If they are of value, expose to the sun for several hours, and turn them over and over again, so that the rays of the sun may penetrate from all sides. Utensils of the patient should be boiled. Disinfect charpoy or iron bed, as the case may be. Mattresses should be disinfected by steam.

7. *Sterilisation of water supplies* :—Provision of properly filtered water supply has been in itself sufficient in stamping

out cholera in Europe. It has also reduced the incidence of this disease in India. On incidence of infection, immediate disinfection of supplies which are exposed to risk of pollution is carried out, by the following methods.

(*a*) Chlorination : Bleaching powder or chlorinated lime is commonly used.

(*b*) Permanganate of potash treatment.

(*c*) Boiling of water in houses to remove the danger of infection.

8. *Supervision of food* :—Food should be well cooked and properly protected from flies and dust. Taking of uncooked or raw food should be avoided.

Aerated water factories should be carefully supervised as to the quality of water being used and secondly the washing of bottles. It is better to wash empty ones with potassium permanganate solution or water containing dilute sulphuric acid, 1 drachm to a pint.

Sprinkling of lime or bleaching powder in slaughter houses, meat shops, sweetmeat shops or other shops, where food is prepared.

9. Efficient and quick removal and disposal of nightsoil and refuse so as to prevent breeding of flies.

10. Health Education :—Handbills or posters should be issued, regarding the means to be adopted by individuals to guard themselves against the infection. The following instructions should be given on the posters or the handbills :—

(*a*) Taking of raw vegetables and unripe or overripe fruits, shellfish or stale foods should be avoided as they give rise to indigestion and so predispose to cholera infection.

(*b*) As cholera is a filth disease, so observe extreme cleanliness in the house. There should be no flies.

(*c*) Milk and water should be boiled shortly before use.

(*d*) The use of bazar-made aerated water, cold drinks, ice creams, etc., should be avoided.

(*e*) Avoid taking purgatives.

(*f*) Avoid going out empty stomach. Promote secretion of gastric juice by keeping the stomach always full as digestive disturbances predispose to the attack of the disease and acid media is hostile to the growth of germs.

(*g*) Butter should be made from boiled milk and should n t be purchased from the bazaar.

(*h*) People should avoid indigestion. They should be temperate in their habits and moderate and regular in their meals. On occurrence of diarrhoea in any individual the medical advice should be immediately sought for.

(*i*) Take hot drinks and hot meals. Weak tea, lemonjuice, curd or butter milk may be taken with advantage.

11. Anticholera propaganda by means of lectures, films and slides should be carried out.

12. Special Measures in Melas and Fairs :—Besides adopting the aforesaid measures the following precautions should also be taken :—

(*a*) Protection of watersupply.

(*b*) Special accommodation and kitchen arrangements.

(*c*) Special bathing places.

(*d*) Proper disposal of nightsoil.

(*e*) Free inoculation, atleast, one week before the arrival of pilgrims.

Treatment :—1. Patient should be kept warm in bed.

2. He should drink glucose water in small quantity frequently. He may be given small pieces of ice to suck, to quench thirst.

3. Sulphasuccidine or Sulphaguanidine 4 tablets with Kaolin one drachm and two tablets with Kaolin one drachm four hourly till vomiting and diarrhoea subsides.

Sometimes the following powder has also been tried with good results :—

Sodium Bicarb.	grs. 5
Calomel.	grs. $\frac{1}{8}$
Caffine.	grs. 2

Mft. pulve one dose. This can be given every two hourly till purging and vomiting stop and then given 6 hourly.

4. Permanganate Pills 2 grains each enteric coated given every $\frac{1}{4}$ of an hour for first 4 hours and then every half an hour till green bile appears in the stools, are now seldom used.

5. In case of loss of fluid, Rogers hypertonic saline should be given intravenously (*i.e.*, Sodium chloride 120 grs., Calcium chloride grs. 4 and aqua one pint). The quantity of fluid is determined by the specific gravity of blood and the blood pressure.

Sometimes alkaline solution of Rogers (*i.e.*, Sodium Bicarb. 160 grs., sodium chloride grs. 90, aqua ad 1 pint) given intra-

venously or per rectum (10 ozs. 2 hourly) till urine output increases to 20 ozs. a day.

DIPHTHERIA

It is an acute infectious and communicable disease characterised by involvement of respiratory system and formation of false membrane of a soluble exotoxin, and peculiar inflammation of the surface membrane of the throat but may affect other mucous membranes or wounds in any part of the body. It occurs chiefly in 3 clinical forms *i.e.*, nasal, tonsiller and nasopharangeal diphtheria. The disease is caused by a *Corynebacterium diphtheriae* (Klebs-Loffler bacillus) which grows chiefly in the throat, larynx and other portions of the upper respiratory passages. It is found in the secretions of mouth, nose and throat and in shreds of mucous membrane. Occasionally it forms membranes on the eyes, and vagina and rarely in infected wounds.

The bacillus is killed by direct exposure to sunlight and heat. It is comparatively a hardy micro-organism.

Severity of the condition depends upon :—(1) Amount of the membrane. (2) Colour of the membrane. (3) Amount of adenitis. (4) Amount of nasal discharge and presence of haemorrhage.

Geographical distribution :—It is a widely spread infection and is more prevalent in temperate regions. It is more urban than rural.

Age :—Although no age is exempted from its attack yet it is common in children between the ages of 3-5 years.

Seasonal prevalence :—The epidemic commences with the beginning of the cold season and its maximum intensity reaches in November and December. It is common in hills during rains.

Predisposing causes :—They are, lowered vitality due to overcrowding insanitary surroundings, sorethroat, nasal cattarh, laryngitis and unhealthy conditions of mouth and throat.

Incubation period :—It is short and usually varies from 3 to 4 days but it may be as short as one day or even only 6 hours.

Mode of spread :—The most common way is by personal communication, chiefly through the *carriers*, whether sick or healthy. Nasal carriers are more dangerous than throat carriers. In majority of cases, the disease is spread by droplet infection, the bacilli being expelled from the mouth and nose by coughing, sneezing, spitting, speaking or kissing.

It may be indirectly transmitted through infected articles such as handkerchiefs, toys, slate pencils, etc.

It is conveyed in some cases by taking contaminated milk and other articles of food. It is traceable to diphtheritic sores on the teats of the cow, presumably infected by a milker carrier.

Fomites may also spread infection. Cross infection in hospitals is common. Infection can spread over patient's own body ; thus a child may infect his finger by picking his nose, or his eyes, by wiping his eyes after picking his nose.

Diphtheria convalescent should not be allowed to mix freely with healthy persons, unless at least two or three successive swabs taken from the throat and nose prove to be negative.

The course of the illness can be described best under 3 headings. (1) Stage of toxaemia. (2) Stage of cardiovascular failure. (3) Stage of paralysis.

Immunity :—One attack of diphtheria is not known to confer immunity.

Schick Test :—It is the test by which the presence of diphtheria anti-bodies in the body of a person are detected. The test consists of giving the intradermal injection into skin of the forearm of 1/50 of a minimum lethal dose for a guinea pig, of diphtheria toxin, diluted to 0.2 c.c. A control test is made on the other forearm with similar amount of toxin, which has been previously heated to 75°C to destroy the toxin. A positive reaction is shown by the appearance of a circumscribed area of redness within 24 to 48 hours and indicates that the person is susceptible to diphtheria. A negative reaction is shown by the absence of reaction in either arm and indicates that the person is immune to diphtheria.

Pseudo reaction : Persons who are sensitive to these proteins, will, irrespective of the presence or absence of anti-toxin in their sera show on both forearms a red flush within 24 hours which fades away completely within 4 days.

Preventive measures :—They are as follows :—

1. *Notification.*

2. *Isolation* :—The patient should be isolated either in the Isolation hospital or at home in a well ventilated room.

3. *Disinfection* of the house is carried out by spraying of 1% solution of formalin. The beddings and the clothings are disinfected with steam. All slates and toys etc., should be boiled for ½ hour. The secretion from the mouth and throat should be received on a piece of cloth and subsequently burnt away. During convalescence, mouth should be washed with some antiseptic lotion. Antiseptic snuffs containing sulphapyridine are worth giving a trial in case of nasal carriers.

4. *Prophylactic immunisation* :—The new born infant is usually insusceptible probably owing to anti-toxin derived from the maternal blood. Immunisation should not be done in children under one year of age. From 1 year to 5 years of age the child is very susceptible and attacks are very often fatal. They need immunisation.

(*a*) Active immunisation gives more durable and permanent immunity and is specially indicated for schools, nurses, and other institutions after performing preliminary Schick test. The underlying principle is that C. *diphtheriae* produces an exotoxin which stimulates the production of antibodies when injected. The following prophylactics are in current use :—(1) Alum precipitated toxoid (A.P.T.) :—A minimum of two injections should be administered, 0·2 and 0·5 c.c. of the toxiod intramuscularly at 4 weeks interval.

(2) Toxoid antitoxin floccules (T.A F.) :—3 doses of 1 c.c. each at an interval of 2 to 3 weeks are administered intramuscularly. It provokes slight reaction and is suitable for adults.

(3) Purified toxoid aluminium phosphate precipitated (P.T.A.P) has been introduced recently. It is less liable to cause local reaction than A.P.T It is given in 2 doses of 0·5 c.c. each at an interval of 4 weeks by intramuscular injections.

Before giving these injections Maloney's test should be carried out to ascertain hypersensitiveness to formal toxoid in a person. It is carried out by intradermal injection of 0·02 c.c., of 1 in 100 formal toxoid. If a wheal arises, the person is supersensitive and the use of formal toxoid is contra-indicated.

(*b*) Passive immunisation is given by injecting 1000 to 2000 units of antidiphtheria serum, to the susceptible exposed child which gives immunity after 24 hours which lasts for 2-3 weeks. The disadvantages are that the immunity lasts for 2-3 weeks and the patient is rendered hypersensitive to serum.

5. *Institutional control* :—When diphtheria has broken out in a community or an institution the whole community should be Schick tested and swabs from throats should also be examined. On the result of Schick test and Swab tests of virulence, the following classification is adopted :—

(*a*) Schick positive (+), swab negative (–), (Harmless susceptible)

(*b*) Schick positive (+), swab positive (+), bacilli avirulent, (Harmless and susceptible).

(*c*) Schick positive (+), swab positive (+), bacilli virulent (Watch and treat with antitoxin).

(*d*) Schick negative (—), swab negative (—) (Harmless and immune.)

(*e*) Schick negative (—), swab positive (+), bacilli avirulent (Harmless but susceptible).

(*f*) Schick negative (—), swab positive (+), bacilli virulent (Dangerous carriers. Isolate from the onset).

Treatment :—1. Put the patient to bed, in absolute rest, owing to the danger of heart failure.

2. Serotherapy has reduced the mortality. The minimal doses advocated are :—

	Units in Thousands			
Age of the Patient	*mild*	*moderate*	*severe*	*very severe*
Children under 5 years of age	3 - 5	5—10	10—20	15—30
Above 15 years and adults	5 —10	10—15	20—40	30—60

It should be given intramuscularly. Concentrated serum contains 2,000 to 2,500 units per c.c. If disease has been prevalent over 48 hours, double doses are needed. Serum should be warmed upto body temperature. Repeat after 12 hours, if there is no improvement. One lac unit of penicillin in normal saline to be injected 3 hourly for 2—3 days. Intravenous glucose is also needed.

3. Give fluid diet till the throat is clear.

4. Tracheotomy or laryngeal intubation may be required for laryngeal obstruction.

SMALL-POX OR VARIOLA

It is an acute infectious disease characterised by sudden onset, with fever, chills, headache, backache, prostration continuing for 3 or 4 days. The temperature then falls. A skin eruption appears which passes through the successive stages of macule, papule, vesicle, pustule, forms crusts and finally scabs, which fall off at about the end of third week ending in pitting or scar formation. The eruption is usually symmetrical and is more profuse and general ; more profuse on prominences, extensor surfaces and surfaces exposed to irritation. It is most abundant and earliest on face, next on forearms, wrists and hands and favouring the limbs especially distally more than the trunks. It is more abundant on shoulders and chest, than on loins or abdomen. It is most communicable in early stages of the disease.

Forms of Smallpox :—It occurs in two forms :—1. Typical or severe type called *Variola Major* :—This occurs in India and is of a classical type.

2 Mild or minor type known as *Alastrim or Variola Minor* and occurs in South America, and U.S.A., etc.

Variola major occurs in three types:—(*a*) *Haemorrhagic Smallpox*: –There are two types of haemorrhagic smallpox which are very malignant. (*i*) Purpuric (black smallpox), with very scanty rash. Haemorrhages occur in the skin, internal organs and mucous membranes.

(*ii*) Variola Haemorrhagica Pustulosa:—In this case haemorrhages occur after the development of rash which may not reach pustular stage. Mortality is 80%.

(*b*) *Confluent Smallpox*.—In this type lesions join together or merge and touch at the edges. It is usually fatal. Mortality is 50%.

(*c*) *Modified or Discrete type*: –The rash is scanty and discrete. The prodromal symptoms are marked. The lesions are short. The modification may be due to vaccination in childhood. Mortality is 10-15%.

In contra-distinction to those of chicken pox, the skin lesions, in smallpox have a hard shotty feel, the vesicles are multilocular, tough and difficult to break; all lesions tend to be at the stage of development and the distribution of smallpox lesions is peripheral. The greater concentration is seen on the face, forearms, wrists, palms, lower legs, feet including the soles. The extensor surfaces of extremities are frequently more heavily involved than the flexor areas. They are relatively sparse on the chest, abdomen and upper part of thighs.

Cause:—It is caused by a filterable virus which is identica- with that of vaccinia. It is present in the secretions of mouth and nose at an early stage and later on it is present in skin eruptions also. The disease is very infectious and contagious. It attacks people of all ages but is fatal, particularly in young children.

Mode of Spread:—The infection spreads directly from case to case. The disease is spread by secretions of mouth and nose of the patient which contains infection, and also from pus of the skin eruptions and by dried scales which are inhaled by a healthy person. Actual method of transmission is not yet proved, but it is presumed to be aerial. This is well known that smallpox can artificially be induced by scabs. In England it has been seen that the infection actually spreads more from the smallpox hospital to the nearest houses than to the farthest places.

Incubation period is 9 to 15 days, and on an average it is 14 days.

Period of Infectivity or Communicability :—It begins with the appearance of rash and lasts till the desquamation of all crusts has taken place. Ordinarily this period is thought to be between 5 to 8 weeks.

Immunity : One attack confers immunity, or it is attained through successful vaccination.

Prevention :—The following preventive measures should be adopted during the outbreak of smallpox :—

1. *Notification* :—Sometimes the cases are concealed. Information regarding the incidence should be obtained through conservancy department in addition to other means of notification.

2. *Isolation* :—The patient should be isolated into a smallpox hospital or an isolation hospital or in home.

3. *Concurrent Disinfection* :—Oral and nasal discharges should be deposited in a paper bag or other suitable container and burnt. All articles concerned with the patient should be sterilized.

4. *Vaccination* :—Is the only weapon to root out smallpox. All contacts of smallpox cases should be vaccinated. Vaccination and revaccination should be vigorously carried out from house to house. Vaccination is done between the age of 3-6 months and revaccination after 4-5 years of primary vaccination. Every man must get revaccination at an interval of 6-8 years.

5. *Care of Convalescent* :—No person suffering from smallpox should be allowed to go out and mix freely with other persons till every scab or scale has disappeared and there is no sore left on the body. The convalescent should be given a bath with soap and water and his clothes should be changed by disinfected ones. It is not uncommon to see children recovered from smallpox in convalescent stage with scabs, on their body, playing about in streets. They are a real source of danger and can cause the spread of the infection.

6. All heads of departments, principals, headmasters, headmistresses, managers of factories, etc., should be informed as to the prevalence of smallpox in a particular locality and carrying out of the immediate vaccination is the only prophylactic measure known for an effective safeguard against the disease. They should be further advised not to allow clerks, students, factory workers etc., in whose houses cases of smallpox have occurred, to attend to their work till the patient is completely cured and house adequately disinfected.

7. *Care of Dead Body* :—All persons who have died of smallpox should be wrapped in a sheet soaked in 4% solution of formalin and should be cremated or buried without any delay.

8. *Disinfection of the House* :—The infected house should be thoroughly disinfected with formaldehyde or sulphur dioxide. The walls should be lime-washed. All articles of clothing, bedding, etc., should be exposed to sunshine during the hottest part of the day. The local municipal committees should endeavour to provide themselves with a steam disinfector and the public should be encouraged to get their articles disinfected therefrom.

9. *Education of the lay public* should be done by handbills, posters, pamphlets, public lectures, films, slides, etc. They should know how to protect themselves against smallpox.

Treatment :—There is no specific treatment. This is mainly symptomatic. Recently sulphonamides (4 to 6 grams daily) or penicillin 30,000 units every 3 or 4 hours intramuscularly is continued for a week.

The mouth and skin require frequent sponging with 1 in 4,000 permanganate lotion and dusting with Boric talcum powder. The eyes are washed with boric lotion and boric ointment is applied to lids.

Diet is restricted to milk, glucose and fruit juice. A saline Diaphoretic mixture and plenty of fluid are also of value.

VACCINATION

It was introduced by Sir Edward Jenner in 1788. Before the introduction of vaccination, it was customary to inoculate persons with variolous matter obtained from a mild case of smallpox, called inoculation against smallpox. It was not a satisfactory arrangement but was very dangerous as in many cases the persons got an attack of smallpox and it developed in the form of an epidemic. This practice is however now prohibited by law.

Vaccination is the introduction of the virus of cowpox or vaccinia into the skin of human beings in order to prevent smallpox. The disease, thus produced, is a very mild affair, showing phenomena of vaccination. This mild disease is effective to save the individual from the dreadful disease *i.e.*, small. pox.

Vaccination is the only and in fact the surest method of prevention of smallpox. It can be absolutely stamped out by systematic vaccination and revaccination in a country.

After its introduction the following methods were employed :—

(*a*) *Arm to arm method* :—Children were vaccinated with he lymph obtained from other children. This method was objectionable as the child was troubled

every time when some other person was to be vaccinated through this method. So this was given up.

(*b*) *Calf to arm method* :—The vaccine was grown on a calf and the child was directly vaccinated from it. This method was widely followed in the Punjab for sometime. It was subsequently given up, as a large number of calves were used and there was no supervision or control over the vaccinators regarding the cleanliness at the time of taking lymph from the calves.

Method of Vaccination :—Healthy persons should be vaccinated. Children suffering from fever, boweltrouble, skin troubles as impetigo or eczema, should not be vaccinated. Do not vaccinate in a home where there is a case of erysipelas.

It is done on the outer side of the arm near the insertion of deltoid muscle or in front of the fore-arm, 2 inches below the bend of the elbow. Care should be taken to protect the vesicles. Sometimes when vaccination marks are not desired on the arm or fore-arm particularly in females, calves of the legs are selected for the purpose of vaccination.

Sterilisation of the Part of the Body to be vaccinated is done by soap and water and then dried. Absolute alcohol is applied and the area is allowed to dry up. Generally no antiseptic is applied, but if applied, it is thoroughly washed with clear water to remove all traces of the antiseptic and the place allowed to dry up prior to vaccination.

Sterilisation of Instruments :—Vaccination needle, lancet or, rotary lancet and probe are used for vaccinating purposes. They are sterilised by passing through flame. They must be cooled before use otherwise they will kill the virus contained in the lymph. They can be sterilised by wiping with absolute alcohol or rectified spirit before use.

Methods :—These are as follows :—(*a*) *Puncture Method* :—It is like tatooing. A few superficial punctures are made through a drop of vaccine with a sterile needle within an area not more than $\frac{1}{8}$ inch in diameter. The needle is kept parallel to the skin. This gives little chance of contamination.

(*b*) *Incision Method* :—This used to be the only method recommended in Germany for sometime. A single linear incision, not more than $\frac{1}{4}$ inch long through the epidermis is made through a drop of lymph or before the lymph is applied. The vaccine is gently rubbed over the scratch.

(*c*) *Scarification Method* :—In this method scarification or cross scratching is done. The objection to this method is that it produces a relatively large abraded surface which is soon

covered by a dry hard crust of serum and blood through which the eruption cannot pierce. The vesicles form a ring around the scarified area leaving a central irritated wound inviting infection. This method is forbidden in Germany.

(d) *By Rotary Lancet* :—The sterilised rotary lancet is placed gently over the part and is given one rotation with sufficient pressure but without drawing blood. Vaccine is applied and rubbed in.

(e) *Multiple Pressure Method* :—It is the best of all the methods because it causes less discomfort, is completely painless, involves minimum trauma and is less likely to be associated with severe local reactions or septic complications. The object of the vaccination is to introduce the vaccinia virus into the deeper layers of the epidermis, where multiplication takes place more easily. In this method a small drop of vaccine is placed on the skin, a flat sided or triangular needle *e.g.* a hagedorn of a large size in good condition which should be sharp and sterile, is held parallel or tangentially to the arm. One side of the needle is pressed firmly and rapidly into the drop about thirty times in 10 seconds. The needle is not driven into the skin, but by the action of needle the lymph is driven into deeper epidermal layers. The excess of vaccine lymph should be gently wiped off the arm.

Number of Insertions :—The number of insertions are three in case of primary and two in case of revaccination. They should be 1½ inches apart so as to prevent them from joining together.

Phenomena of Primary Vaccination :—There may be inflammatory reaction *i.e.*, reddening and itching during the period of incubation *i.e.* for three days. On the third day papule appears which is superficial, round, hard and red in colour which becomes slightly elevated on 4th day when one or more small papules appear.

After the fifth day, it vesiculates, becomes multilocular, umblicated, and is surrounded by an inflammatory red margin, called the Areola. The vesicle has a doughy or tense feeling and does not fluctuate. It is characteristic on the 7th day. On the 8th day, it becomes flattened, larger and the umblication or the depression practically disappears.

On the 9th day, it is flattened and less full and becomes pustular. It is then greyish, tense, loculated and full of lymph. It develops to its maximum size on the 12th day. During this period, slight constitutional symptoms such as headache, malaise,

fever, swelling and tenderness of regional lymph glands, restlessness and itching are observed.

A brown crust or scab forms on the surface on the 14th day which dries up and falls about on the 21st day. The scar is first red and finally becomes white and depressed and marked with little pits.

Age for Vaccination :—It must be done in infancy when the child is three months old and in no case later than six months. Infants may be vaccinated as early as one week of age but are less responsive to stimulation at the time.

If there is any reason to suspect that child may develop smallpox or there is an epidemic of smallpox in the locality, vaccination should be performed atonce.

If primary vaccination is successfully done immunity for smallpox will last for five or six years. Revaccination should be done at the time when the child enters school at the age of 5 or 6 years and again at the age of ten to twelve years and at the age of twenty years.

Vaccination after Exposure to Smallpox :—A person who has been in contact with a case of smallpox and who gets vaccinated at once, usually escapes the disease or in the event of an attack of the disease it is very much modified. The reason is that the incubation period of vaccinia is shorter *i.e.*, 8 days and that of smallpox is longer *i.e.*, 12 days, so the vaccinia virus has four more days to act. Successful vaccination may therefore be performed at any time during the incubation period of smallpox.

Reactions of Primary Vaccination :—If phenomena of vaccination is observed, in at least, one out of two insertions, the result is successful. If the result is unsuccessful, vaccination should be repeated again at the end of a month. If again it is unsuccessful it may be repeated for the third time, at an interval of three months until successful. If the result is unsuccessful even at the third time, the conclusion is that the child has got natural immunity against the disease.

If there is no phenomena of vaccination or absence of a take, after primary vaccination in newly born child, it may be due to one of the following causes and that cause should be investigated: –

(*i*) Technique of vaccination may be wrong.
(*ii*) Vaccine may not be effective or potent.
(*iii*) The child may have natural immunity.
(*iv*) The child might have wiped out the vaccine by dropping the sleeve over the arm before it was dry.
(*v*) Application of vaccine to the cleansed skin, before it is dry.

(*vi*) The application of a bandage or a shield.

Reactions after Revaccination :—There are three types of reactions :—

(*a*) *Reaction of Immunity or Immediate Reaction* :—A papule appears on the first day. It does not develop into a vesicle and rapidly subsides. This shows that the person has got immunity.

(*b*) *Accelerated or Vaccinoid Reaction* :—A papule appears on the second day, a vesicle on 3rd day and a pustule on 4th day, whereas scab starts on the 5th day and finally falls off on the 8th day. This shows partial reaction ; in other words, the individual has got partial immunity. Longer the interval between vaccination and revaccination the resulting reaction will be more nearer to the reaction of primary vaccination.

(*c*) *Typical Primary Vaccinia or Vaccinia "Take"* :—This shows that there is no immunity and so phenomena of vaccination is observed.

Complications of Vaccination :—There may be :—(*a*) *Post vaccinal Encephalitis* :—It develops ten days after vaccination. The onset is sudden ; the symptoms include fever. headache, vomiting, drowsiness, passing into coma. Mortality is 50%. The exact cause is not known. It occurs most frequently in primary vaccination after the age of infancy or due to the use of neurotropic virus.

(*b*) *Vaccinia* :—Local and general. It might follow infection carried through hands or otherwise by the nursing staff. One patient may infect another or distant parts of the body. It is not uncommon for a mother to be infected by a child who is vaccinated.

(*c*) *Tetanus* :—It occurs as a result of contamination although it is almost unheard of.

(*d*) *Autovaccination* is due to scratching the virus with fingers and then introducing them into mouth, nose, eyes or any other part of skin. It may cause blindness.

(*e*) *Generalised Vaccinia* is noticed if revaccination is done after a long time of primary vaccination.

(*f*) *Septic Condition* is due to infection of the vaccinated part. Strepto or staphylococcus infection or erysipelas may occur.

Vaccine lymph :—It is a preparation of vaccinial material obtained from the vesicles produced on the skin of healthy animals by the inoculation of vaccinia virus.

Manufacture of Vaccine Lymph :—It is manufactured from buffalocalves, cowcalves or sheep. Healthy buffalocalves are selected by a veterinary surgeon and are kept in quarantine for 7 to 10 days. 30 c.c. of antirinderpest serum is injected to each of them. They are given a bath with hot water and soap. The abdomens of the calves are shaved and the shaved area is washed with soap and water. It is subsequently washed with 50% ether-soap solution and finally with sterile distilled water. This area is dried with a sterile towel. Then linear parallel scarification is done on the entire abdomen and seedlymph is applied thereupon with a spatula. These calves are then kept in incubation shed for 5 days. At the end of this period confluent vesicles appear over the vaccinated area. The calves are then taken to operationroom and subjected to the same washing procedure as was done prior to vaccination. The vesicles are scraped off by Volkman's spoon and the pulp is collected in metallic bottles of a known weight. The pulp is stored at—11°C.

Preserving it with Glycerine :—It is then mixed with 5 times its weight of sterilised mixture of 50% glycerine in distilled water and the whole mixture is ground in an electric grinding machine (preferably chalybus lymph grinding machine), and thus a fine emulsion is prepared.

Purification is done by the action of chloroform vapours or by addition of ether. This kills most of the extraneous organisms. Bottles are kept in a cool incubator at 22°C for 18 hours. Subsequently deetherisation is done to remove any residual traces of ether in the lymph.

Testing of the vaccine is done in the following ways :—

(*i*) Purity tests.
(*ii*) Safety or pathogenicity test.
(*iii*) Potency test.
(*iv*) Field test.

I. Purity Tests :—1. Colony Count :—1 c.c. of vaccine lymph should not contain more than 20,000 micro-organisms.

2. 1 c.c. of vaccine lymph should not show presence of Bacillus coli or Streptococcus haemolyticus.

3. 1 c.c. of vaccine lymph should not show presence of Bacillus tetanus or Bacillus anthrax.

II. Safety or Pathogenicity Test :—5 c.c. of neat vaccine lymph is injected into a guineapig which is previously vaccinated. The animal is kept under observation for a fortnight. During this period it should not die or develop any symptoms of the disease.

III. Potency Test :—I in 1000 dilution of vaccinelymph should give a perfectly confluent take on vaccinating a rabbit.

IV. Field Test :—Vaccine is tested by doing primary vaccination on children and their results are recorded. It invariably gives 100% successful case rate and nearly 100% insertion rate.

CHICKEN-POX OR VERICELLA

It is a mild communicable disease of sudden onset with slight fever, mild constitutional symptoms and rash which passes through the stage of macule, papule and crust. It occurs in children mostly in an epidemic form. It very often coincides with epidemic of smallpox. The rash is most abundant on the trunk usually appearing first on the chest without prodromal rashes or systematic disturbances and the vesicular stage is noticed first. In the children it appears on the first day. The ordered sequence of small-pox is absent; the lesions continue to come out in crops so that crusts and vesicles may occur side by side. The vesicles are unilocular.

Complications :—They are bronchopneumonia, otitismedia, conjunctivitis, and panophthalmitis.

Etiology :—Its exact cause is not yet known. It is considered to be due to a filterable virus. It spreads by contagion from a previous case. The virus is conveyed by droplet infection or by air or by personal contact. Fomites convey infection in rare cases.

Immunity :—One attack generally confers immunity for the rest of life.

Incidence :—It is greatest during the first ten years of age. It occurs rarely in adults.

Incubation Period :—About 14 days.

Mortality :—Practically nil.

Period of infectivity :—Usually 3 weeks.

Prevention :—

1. Notification of the case to the medical officer of health. The diagnosis should be confirmed.
2. Isolation of the patient. The measures taken to prevent smallpox are also applicable to chicken-pox. The serum obtained from a convalescent patient within a month after the appearance of rash has been used for prophylactic purposes, but it has not proved very satisfactory.

Treatment :—There is no specific treatment.

MEASLES (MORBILLI)

It is most common, highly communicable and a specific infectious disease affecting children. Its onset is characterised by sneezing, laryngitis, brassy cough, running of the nose and eyes, photophobia, fever, macular eruption which is velvety to touch. An early sign is the presence of "*koplik spots*" in the mouth *i.e.*, minute bluish white specks which may be seen on the gums and inside cheeks but not on the palate. It occurs generally in an epidemic form and is infectious from the very beginning. Its distribution is universal. All races are susceptible to it.

Etiology :—It appears to be a virus present in the nasal secretions, scrapings of skin etc., which has been recently identified in "tissue culture".

Mode of spread :—The disease is transmitted from the sick to the healthy by means of direct contact, through discharges from the nose and mouth. Its propagation may be effected indirectly through the agency of infected articles, toys, etc. The infection may be given off by breath and mucus. There are no carriers. The patient is infectious for first 7 days of illness.

Incubation period :—10-11 days.

Infectivity :—The disease is most infectious in preeruptive stage and its infectivity rapidly declines, when the rash begins to fade that is during a period of about 8 days after the appearance of the rash, which usually appears on the 4th day.

Age :—It attacks children under 5 years of age. Adults are also susceptible to this disease.

Seasonal prevalence in India :—It occurs from November to April.

Complications:—These are many and are serious *i.e.*, respiratory as bronchitis, broncho-pneumonia ; gastro-intestinal as diarrhoea ; central nervous system as convulsions and encephalitis.

Death rate :—It is higher among poor who live in overcrowded localities than the rich living in well-ventilated houses. It is most fatal of all the diseases in children under 5 years of age.

Quarantine :—(*a*) *For contacts*, 18 days.

(*b*) *For sick* :—Until desquamation and subsidence of the catarrhal conditions are complete.

Immunity :—One attack confers immunity for rest of the life. Newly-born infants are immune to measles for a few months.

Prevention :—This is the most difficult disease to handle as it is most infectious in its preeruptive stage. Moreover, it has got a long incubation period.

1. The suspicious cases should be isolated at once without waiting for the rash to appear.
2. Compulsory and prompt notification to the health authority of the area.
3. The nasal and buccal secretions should be wiped out with pieces of cloth and burnt away.
4. Application of carbolised glycerine or vaseline to the body.
5. The clothes, beddings and the sickroom should be disinfected properly.
6. Children from the infected house should not be allowed to go to school and if there is outbreak of an epidemic in the town, the school may be closed.
7. Convalescent serum or gamma globulin or serum of adults has been tried intramuscularly within 3 days of exposure for prophylactic purposes, and it appears to be of much use.
8. Virus inoculation has also been tried in America with good results.
9. Prophylaxis on general hygienic lines, consists in raising the standards of housing and nutrition.

Treatment :—The patient must be kept in bed and symptomatic treatment be given for bronchitis, laryngitis or conjunctivitis. Regular nursing toilet of the mouth, lips and eyes is comforting and preventive of secondary infection.

Sulphadiazine 0·5 G. three times a day for a child of 5 years should be given for 5 days. It is effective in preventing complications.

MUMPS (INFECTIOUS PAROTITIS)

Mumps in an acute infectious disease of sudden onset, characterised, by fever, general malaise and by enlargement and tenderness of one or more salivary glands usually of the parotid. It lifts the ear and gives the face a whimsical appearance. It is first unilateral, passing later on to the other side. Trismus is well marked and pain may be felt at the angle of the jaw before swelling appears and mouth cannot be opened properly.

Cause :—It is caused by a filter passer virus which is present in saliva, blood and cerebrospinal fluid. For its spread a close contact is necessary.

Incubation period :—It is from 17 to 26 days.

Age :—The infection is mainly of childhood and adolescence.

Infectivity rate :—It is high.

Complications :—They are orchitis in males, mastitis and oophoritis in small proportion in females. It may cause deafness in rare cases.

Prevention :—The following measures should be adopted :—

1. The patient must be isolated until swelling of salivary glands is subsided. Treatment is begun with a purge. Mouth washes may be used and hot fomentation or Icthyol Belladonna paint is applied to the swollen parotids. All patients near puberty should be kept in bed for 10 days. In adolescents, 10 c.c. of convalescent serum be given to check the complications. Sulphonamides be given for preventing secondary complications.
2. All utensils should be boiled.
3. Movements of the contacts may not be restricted.

Treatment It is symptomatic. In orchitis surgical relief of pressure has been of much use. The use of steroids has also shown some success.

ACUTE POLIOMYELITIS

Acute poliomyelitis or infantile paralysis is one of main crippling diseases of childhood. It is an acute infectious and communicable disease affecting the central nervous system and infrequently resulting in paralysis. It attacks children of all ages.

Cause :—It is a filterpasser virus, which is found in naso-pharyngeal secretion, faeces and urine of patient and carriers. The carriers play an important part in the spread of the disease. Faecalcarriers are more dangerous than the nasopharyngeal ones. The causative agent invariably involves the nervous system, especially nerve cells of spinal cord and medulla oblongata. The seriousness of disease and its after effects depend upon the extent of damage that the virus does to the nerve cells. If they are only slightly damaged, complete recovery is possible. But if a nerve centre is completely destroyed by the virus infection, then the muscles controlled by it are permanently paralysed since the nerve cells once dead cannot grow again. It may be conveyed through water or milk. Hot dry weather tends to foster epidemics.

Incubation period :—It is usually 7 to 14 days but sometimes it may be only 3 days.

Symptoms :—It shows two stages :—1. *Preparalytic stage* :—The attack of poliomyelitis begins with high fever, coryza, headache, chilliness, pain all over the body and occasionally epistaxis. Children are drowsy but the adults are restless. It is followed by irritability and rigidity of neck. Cerebrospinal fluid remains clear in this stage.

2. *Paralytic stage* :—After the first stage there is recovery for 2-3 days and then second stage follows, with its characteristic implication of group of muscles. The "*spinal sign*" of this stage is the pain produced, when the attempt is made to bend the spine forward. The paralysis is of a flaccid type, shows great variation in degree and range. The limb seems to be loose and flake like. Foot drop, irritability to raise the arm and straighten the leg, facial paralysis and squinting of eyes are the result of this disease. If muscles of larynx and pharynx are involved, it proves fatal.

Class of people :—It attacks all classes of people ; sometimes well-to-do persons are affected. In England mostly public schools were affected with this disease.

Mortality :—It ranges between 10 and 20%. Fifty per cent of those, who escape death, are crippled in various ways and sequelae include permanent muscular paralysis, atrophy of limbs and deformity of joints.

Prevention and control :—The following measures should be adopted :—1. Notification of the case to the health authorities.

2. Isolate the patient. Give him complete rest in bed and treat the symptoms as they arise. Mechanical respirator or "*Iron lung*", is required, when the paralysis attacks the muscles of the chest.

3. Since polio virus has been found in the bowel waste products and in sewage, indiscriminate disposal of nightsoil particularly of patients suffering from this disease is dangerous. There must be provided therefore an adequate arrangement for proper disposal of urine and faeces.

4. All sources of water supply should be protected. During the outbreak of epidemics, swimming baths should be chlorinated.

5. Overcrowding of children in schools, playgrounds and cinemas should be avoided.

6. Soft fruits should be washed in weak permanganate solution and milk should be pasteurised.

7. Antifly measures in wellequipped orthopaedic clinics should be adopted

8. Poliomylitis vaccine discovered by Jonas Salk is a preparation of formalin killed virus combining antigens of 1, 2 and 3 and is said to be effective in preventing paralytic poliomylitis in about 75% of persons who were vaccinated. The vaccine is administered in 3 injections of 1 c.c. each ; the first two being about 4-5 weeks apart and the third about 6-7 weeks apart or even later. Convalescent sera for prophylactic and curative purposes have been tried but the results have so far been inconclusive.

9. All suspected carriers, should be treated with potassium permanganate gargles and 4 tablets of sulphadiazine daily.

10. For residual paralysis, ambulatory treatment, massage and muscle reeducation without fatigue are the proper measures during the stationary stage, which begins some 2 years after the acute attack. Deformities may require to be corrected by the use of plaster, forcible stretching, tenotomy or similar surgical procedures.

Treatment :—It is symptomatic. Use of sulphonamides have been found of service in prevention and treatment of respiratory and aural complications. Treatment by way of fomentation and massage, which must be given for a long duration of time, help temporarily, weakened muscles to grow strong and useful again.

CEREBROSPINAL FEVER

It is a specific infectious disease characterised by a sudden rigor, fever, severe headache, and symptoms of meningitis, that is, rigidity of neck or retraction of head. *Kerning's sign* is present and pulse is slow. Patient becomes apathetic.

Etiology :—The disease is caused by the organism *Diplococcus meningitidis intracellularis* now commonly known as *Neisseria Meningitidis or meningococcus* and is found in the cerebrospinal fluid of patients and naso-pharynx of carriers of the disease.

Incubation period :—It is 2-10 days.

Mode of spread :—The disease is spread by healthy carriers rather than the cases. Cases are doubted as source of infection. They are mildly infectious during the course of disease. The person attending the patient often becomes a carrier. He rarely contracts the disease. Infection takes place by aerial or droplet infection. The predisposing cause is the saturation of the air with water vapours. Under conditions of great humidity the nasopharyngeal mucosa becomes more spongy and permeable. Carriers play a most important part in this disease. An epi-

demic of cerebrospinal fever is heralded by an excessive increase in the number of carriers. Adults act as carriers and children suffer from the disease.

Incidence :—It is mostly prevalent in children and young adults. No age is exempted from its attack.

Seasonal prevalence :—The highest prevalence of the disease is from February to April. It is common in jails, barracks, schools, army, etc.

Complications :—Facial or other paralysis, blindness or deafness.

Mortality :—It is high. It may be from 20 to 75% among infected.

Prevention :—1. Isolation of cases and contacts should be segregated for 3 weeks.

2. Efforts should be made to prevent overcrowding. Fresh air and sunlight should be provided.

3. Antiseptic gargles should be used. Spraying of throat or other local treatment should be tried.

4. Swabs of nasopharynx of all the contacts should be bacteriologically examined and contact carriers should be treated with sulphadiazine. Sulphadiazine is also used to reduce mortality from the disease.

5. Prophylactic vaccines in 3 doses have been prepared and tried with some success.

Treatment :—Penicillin should be injected in the doses of 30,000 units every 3 hours until 7 or 8 millions units have been given. Alternatively sulphathiozole or Sulphadiazine should be given in daily doses according to the age. Dehydration be prevented by giving fluid by mouth or by injecting normal saline.

THE COMMON COLD

A cold in head or *Rhinitis or Coryza* is an acute highly communicable disease characterized by catarrhal inflammation of mucous membrane of nose, paranasal sinuses, pharynx, larnyx, trachea, bronchi etc. It is most common of all diseases, for there are very few people who escape having from one to three colds a year and each cold lasts on an average 2 to 5 days. If the cold is neglected, it may lead to serious complications of upper respiratory tract. Although one may not be actually in bed during this time, his work decreases in efficienc.y The greatest economic loss out of all sickness may be attributed to the common cold. In schools, the most frequent reason for class absences is colds.

Causes :- Colds are caused, by a filterable virus. Any individual no matter how healthy he may be, if he comes into contact, with some one having cold, may contract it. However, there are factors which make one more susceptible, such as dry overheated rooms, sudden changes in temperature, drafts, improper food, obstructions of the nose, fatigue, exposure to cold and wet ; in fact any condition which produces lowered vitality. One may have symptoms resembling a cold from the inhalation of dust or chemicals or one may have a non-infectious allergic rhinitis.

Mode of transmission: –It occurs by direct contact or by droplet infection or through fomites. Period of communicability ranges from 24 hours before onset to 7 days after onset.

Symptoms :—A cold manifests itself by the mucous membrane of the nose becoming swollen, the secretions copious and the eyes watery. The nose becomes obstructed and this in turn produces a temporary loss in smell and taste. Sometimes fever and aching in the back and limbs become outstanding symptoms.

Treatment :—There is no specific therapy to cure common cold so far. Most colds run a regular course, although early treatment will usually shorten the attack. Rest is perhaps the greatest factor in their treatment. The hot bath which is often highly recommended should be used cautiously.

If one perspires freely after a hot drink and hot bath, he is likely to become chilled as his clothes dry up and his cold may become worse.

The diet should consist of foods easily digested, such as fruits especially the citrus fruits, green vegetables, eggs, butter and milk. If the cold does not improve quickly after simple treatment, a physician should be consulted. One should watch closely for a skin eruption as a seeming cold might be one of the other communicable diseases such as scarlet fever or measles.

Overwork and late hours while recovering from a cold may cause a relapse, which is usually more severe than the initial infection.

A reinfection may take place by using the same handkerchief or cleansing tissue too long. Hands and handkerchiefs should be washed frequently while one has a cold or paper handkerchiefs can be used with little expense and subsequently burnt.

Coldvaccines are of limited value and have not proved especially efficacious either in prevention or cure of colds, but in some cases they prove to be of temporary value. The indiscriminate use of antibiotics, nasal drops and of solutions to be sniffed up the nose should be guarded against, as they prove injurious.

Blowing the nose hard, no matter, whether it is on one or both sides, while one has a cold may cause ear infection or sinusitis. If one has frequent colds, even though they are not severe a physician should be consulted. Antihistamine drugs have come into use in colds caused by an allergy.

The virus of common cold or rhinitis may extend into the throat and result in tonsillitis, pharyngitis or laryngitis, or into the bronchi causing bronchitis or into the lungs when pneumonia may result. Colds are regarded too often as trivial. Therefore any one careless, when having a cold lacks a proper sense of social responsibility. Probably the best medicine for avoiding the cold is to gargle the throat with common salt in warm water.

Prevention :—The prevention of colds means the prevention of the spread of the secretion from the mouth and nose of individuals who have colds. Every tiny drop of secretion from the nose and mouth of the individual who has cold is filled with germs and is contagious. It seems to be more contagious in early stages of the disease and one should carefully protect others at this time. Isolation of the individual during the first one or two days of acute rhinitis will often help to prevent its spread. Keeping up one's resistance through out-door exercise, wholesome food, plenty of rest and proper ventilation is important in prevention of cold.

Chilling the body by too little heat or too little clothing lowers the resistance to colds. Temperature, moisture and circulation of air in houses are important factors in the prevention of colds.

Cold drafts should be avoided. Glycol spray should be used on floors, walls and bedding in the barracks for airborne diseases. The spray appears to reduce their spread.

INFLUENZA

It is an acute highly communicable febrile disease, characterised by fever, headache, chills, great prostration, pain in limbs and the back and frequently by inflammation of the respiratory and gastro-intestinal tract and vomiting.

It assumes pandemic form after certain intervals and spreads over all parts of the world *e.g.*, influenza of 1919.

Etiology :– It is a filterable virus of which there are three strains, A. B. & C. Until last epidemic *pfeiffer bacillus* was believed to be its cause. One view is that *pfeiffer bacillus* is only a complicating agent like streptococcus haemolyticus, pneumococcus, etc.

Incubation period :—It varies from 1 to 4 days.

Mode of spread :—The virus is present in the nasal discharges and the sputum. The infection usually spreads from one person to another directly *i.e.*, minute particles of sputum contain the virus and may be present in fomites also. It is highly contagious and occurs in all seasons and attacks all ages. Nearly every body is susceptible to it. This disease is most infectious during its first 3 days. Carriers probably play a part in its spread.

Fatigue, overcrowding, illventilation, exposure to dusty and chilly atmosphere are important predisposing causes. Railways, cinemas, etc., also play a great part in the spread of the disease.

Immunity :—It does not confer immunity and subsequent attacks are comparatively more severe.

Prevention :—Isolation of cases be rigorously enforced. Cinemas, theatres, etc., should be closed as there is a risk of getting chill, on suddenly getting out of these congested places. Overcrowding of every sort should be avoided. Wellventilated rooms and avoidance of draught should be encouraged. Chilling of body should be prevented by wearing warm clothes.

Hygienic living, taking of good nourishing diet, and avoidance of overwork are the main precautions to be observed in the event of outbreak of the disease. Antiseptic throat gargle should be done and a bit of cinnamom be kept in the mouth. Moreover, sneezing, spitting and coughing in public places should be avoided.

Closewoven muslin of about 40 mesh to an inch or gauze facemask should be used while attending a patient. The clothes, beddings, handkerchiefs and the room used by the patient should be thoroughly disinfected. Secretions from nose and throat of the patient should be received in a spittoon containing some disinfectant. As there is a risk of conveying infection by hands, so they should be immediately washed after their coming in contact with the patient.

Prophylactic vaccination :—*1*. Attempts have been made to prevent or modify the disease by injections of living attenuated virus but the results are inconclusive.

2. *Vaccination by formalised virus* also gives encouraging results.

3. *Passive immunity* is produced by giving an injection of convalescent serum.

Education of the public regarding the mode of healthy living and prevention of catching and spreading infection by pamphlets, posters, handbills etc., is very essential.

Treatment :—There is no specific treatment for influenza

except general supportive measures for upper respiratory infection.

WHOOPING COUGH OR PERTUSSIS

Pertussis is an acute respiratory infection, caused by *Bacillus pertussis or Hemophilus pertussis* involving the trachea and bronchi and characterised by an initial catarrh, with insidious onset and irritating cough, lasting for a few days to several weeks, merging into a stage the chief feature of which is a series of severe paroxysmal cough, in which the face becomes suffused, the tongue protrudes, the saliva is blood stained and finally vomiting takes place.

Incubation period and Period of Communicability :—The incubation period is often about 7 days, the limit is 21 days. The period of danger of the spread of disease, extends from 7 days after exposure, to three weeks after onset of typical paroxysm.

Mode of spread :—It is most infectious, before it is diagnosed *i.e.*, in the early catarrhal stages and the infection spreads directly from person to person by droplet infection. It is probable that inhalation of recently infected dust from clothes or bedding may be an important factor. The main source of infection is nasopharyngeal, laryngeal and bronchial discharges.

Age :—Whooping cough occurs in all ages, but is preeminently a disease of young children. The case mortality in the first year of life is about 10%. Of the total deaths about 90% occur under the age of 5 years.

Sex :—It is rather commoner in females, though case fatality is the same for both sexes.

Seasonal Incidence :—It varies but death rate is highest in later part of winter and spring *i.e.*, during March and April.

Complications :—They are epistaxis and subconjunctival and other haemorrhages, convulsions, hernia, bronchitis and bronchopneumonia and ulcer of frenulum linguae in children.

Sequelae :—Cardiac dilatation and in some cases tuberculosis.

Treatment :—It is symptomatic. Paregoric may be given for cough and belladonna is helpful as an antispasmodic. Sulphonamides are said to reduce the risk of fatal termination. Open air treatment is an important adjuvant. Hyperimmune rabbit serum, streptomycin and other antibiotics have been tried and have proved useful.

Control :—The theory that every child must have whooping cough during one stage or the other of his life is incorrect. Whooping cough like other infectious complaints can be avoided,

if due precautions are taken at the right time. The first and the most important item in prevention of the spread of the disease is early diagnosis, in the individual patient and his isolation. He should be excluded from the school for a period of 6 weeks.

Several pertussis vaccines are available for prophylaxis. Four doses of sauer vaccine are recommended to be given between the ages of six months and two years and a boosting dose may be given at the end of second year. A period of one week should lapse between each of the first three doses and a month between the third and the last dose.

A temporary immunity may be conferred on young children, who are exposed to immediate risk ; by administrating an injection of convalescent serum.

TUBERCULOSIS

It is caused by *tubercle bacillus*, which was first discovered by Robert Koch in 1882. It belongs to genus Mycobacterium. It is a very hardy micro-organism and can live in dry state for six months. When exposed to direct sunlight it is killed after eight hours. It is also destroyed by boiling for 10 minutes. All warm blooded animals seem to be susceptible to this disease. This is prevalent both in tropical as well as temperate climates and is more prevalent in large overcrowded cities and towns. All domesticated animals may suffer from tuberculosis. Cows and buffaloes in India do not suffer from tuberculosis to the same extent as in England as they live in open air and sunshine during most part of the year. Goats are immune to this disease.

Symptoms in Pulmonary Tuberculosis :—The onset may be insidious or acute. A common mode of onset is an acute transient febrile illness accompanied by respiratory cattarh and malaise. The most outstanding of these early manifestations are haemoptysis and pleurisy. The characteristic symptoms are :—

1. Excessive fatigue—Patient is exhausted in ordinary daily work.
2. Loss of weight.
3. Failure of appetite.
4. Amenorrhoea in females.
5. Slight rise of temperature in the evening.
6. Husky cough.
7. Night sweating.
8. Slight palpitation.
9. Rapid pulse.

Later symptoms :—The toxaemia is shown by swinging of temperature. The body is wasted, the cheeks are flushed, the eyes bright and sunken, and the lips are dry. The fingers may be clubbed. The breath has peculiar odour ; the sputum is copious and puerulent. There is often an unnatural sense of wel-being and hopefulness of recovery. Besides the retraction of the upper part of the thoracic wall and displacement of mediastinum, immobility over the diseased areas of the lung will be noted. Over extensive infiltration, air entry and movements are often restricted and rales and rhonchi are heard. Consolidation is characterised by impaired resonance.

Modes of infection :—They are :—1. Infection by inhalation of droplets expelled by tubercular patients, through coughing, sneezing, yawning and loud speaking, upto a distance of 3 feet is called droplet infection.

2. Inhaling fine dust containing tubercle bacilli derived from dried sputum and other infected discharges thrown on floor, walls, furniture, clothes, etc., which disintegrate into fine atomised particles.

3. Infection may occur by handling sputum or other discharges of tubercular patient and therefrom contaminating articles of food and drink.

4. Through the ingestion of articles of food and drink contaminated with tubercle bacilli.

5. By direct contact by inoculation into skin or mucous membrane *e.g.*, kissing or using common glasses or tumblers, cups, pipes, etc.

6. Children sometimes get the infection by taking milk infected with tubercle bacilli *i.e.*, milk derived from a tubercular cow.

7. A child at birth even from tubercular parents, is not tuberculous. It is by contact with contagious cases that children begin to get infection from a few months after birth. Hereditary transmission of tuberculosis does not occur.

8. Flies play an important part in the transmission of disease by mechanically infecting articles of food and drink.

Infection depends on several factors, such as :—

(*i*) The virulence of the tubercle bacilli introduced in the body.

(*ii*) Dose or the number of bacilli introduced.

(*iii*) Frequency of infections.

(*iv*) Path of infection, whether through susceptible tissues or not.

(*v*) The sensitiveness of the individual.

Control or Prevention of Tuberculosis :—*A. General measures* :—

1. Attend to the general sanitation. Live in open air and sunshine.
2. Proper construction of streets and buildings. The streets should be wide. There should be plenty of free space between and behind the houses. There should be no back to back house construction. There should be ample open spaces, gardens and parks in or near all the congested localities. Unhealthy congested areas or slums should be demolished. Improvement schemes should be launched.
3. Regulation of unhealthy trades and proper precautions should be taken to prevent inhalation of dust.
4. Supervision of articles of food and drink should be strict. Veterinary surgeons should be employed to inspect meat and also the animals meant for slaughtering. They should also inspect milch cattle in dairy-farms and milk in the dairies.
5. Improvement in the standard of healthy living, by taking nourishing food and living in better houses etc. Purdah system deserves to be condemned.
6. Education of people through propaganda by leaflets, magic lantern slides, lectures, films and film strips. The public, especially the phthisical patients, should be forbidden to spit everywhere. Spittoons should be provided in factories, offices and other public places.

B. Specific measures :—1. Compulsory notification :—This measure should be enforced. The patients of this disease are seldom notified by medical practitioners. There is a tendency to conceal the incidence of this disease, so that it may not serve as a stigma to the rest of the family.

2. Separation of babies after birth from tuberculous parents.

3. A complete Antituberculosis Organisation :—It consists of.—(*a*) *Tuberculosis dispensary or clinic system* :—Its functions are :—

(*i*) To examine and diagnose cases of tuberculosis.
(*ii*) To advise patients regarding the treatment and supervision of treatment of all persons suffering from tuberculosis.
(*iii*) To examine and trace out the contacts through tuberculosis nurses or health visitors in houses and schools and detect the incidence of tuberculosis at an early stage.
(*iv*) To arrange for after-care of persons discharged from institutions and offer them suitable wage-earning

vocations, and to settle them in tuberculosis colonies or industrial settlements.

(v) To serve as an information bureau and propaganda centre regarding the incidence of this disease and its prevention.

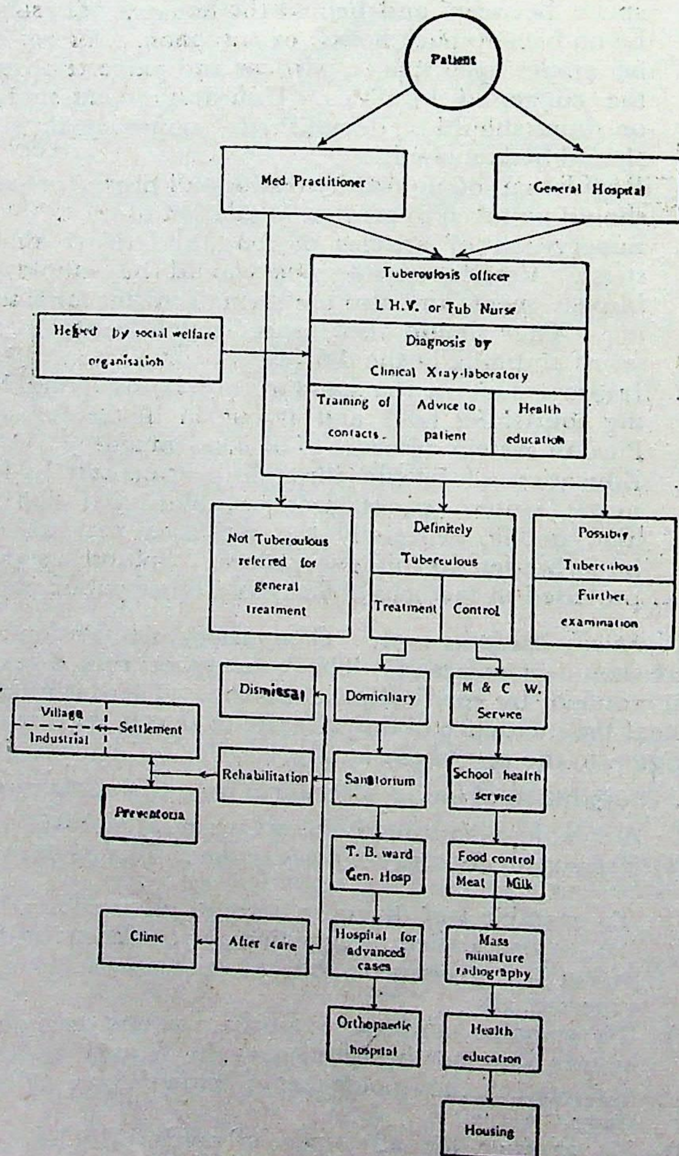


Fig. 66 Lay out of Tuberculosis Control

(*vi*) To serve as a curative centre.

Building :—This should consist of a waiting hall, doctor's room, a few examination rooms, a pathological laboratory, X-ray department, a health visitor's bureau, a record room and a small dispensary.

Staff :—

1. Medical Officer :—The doctor should have specialised training in tuberculosis. There should be one doctor for every 200 deaths from tuberculosis per annum.
2. Tuberculosis nurse or a lady health visitor.
3. Clinical and laboratory staff.

Site :—It should be centrally located and easily accessible.

Provision of one dispensary for every 150,000 to 200,000 of population is necessary.

(*b*) *Hospital and Sanitorium* :—Hospitals are meant for advanced cases and sanitoria for early cases, where they are trained to take care of themselves and after discharge safeguard themselves against the reactivation of the disease. The site at a higher level, away from any possible nuisance is usually selected for a sanitorium to promote the health psychology and physiology of the patients. But hospitals can be located any where.

Sanitorium should be situated at a place with less rainfall protected from the sun and the wind. There should be maximum sunshine and adequate water supply available. The soil should be dry and porous with capacious land round about, planted preferably with pine trees. It should not be situated on very high hills. In India, sanitoria are also being built on plains to reduce the cost of maintenance.

(*c*) *Domiciliary treatment* :—It has never been possible to hosipitalise all cases present in the community at a given time, owing to the small number of beds available in tuberculosis institutions. So domiciliary treatment must be resorted to in majority of cases. Patients with limited involvement, in comfortable homes, where there are no children, and able to take hygienic precautions, may be allowed to remain at home. In home treatment and care of patients and their families, the health visitor and the care committee play an important part. Open air shelters, where the patients can be kept during the day should be tried.

(*d*) *Village Settlements or Tuberculosis Colonies* are arranged near the sanitorium or tuberculosis dispensary so that proper supervision may be carried out. In such colonies, chief industries are carpentry, book binding, cabinet making, upholstery, manu-

facture of fibres, printing, framing, basket and mat making, etc. Here the patients spend most of their time in the open air for diversional or occupational therapy. Arrangement is also made to employ ex-tuberculosis patients to enable them to take part again in social and economic life of the community.

(*e*) There should be close cooperation between tuberculosis clinics, medical practitioners and medical officers in charge of various hospitals.

(*f*) Creation of *Care and After-care Committees* to work in connection with tuberculosis dispensaries, hospitals. sanitoria and village settlements of colonies.

(*g*) *B. C. G. Vaccination or Prophylactic Immunisation* :—*Bacillus calmette guerin* is a living bovine strain of tubercle bacillus which has been rendered avirulent and is used for the preparation of vaccine for immunisation.

Technique :—It is carried out in two stages :—1. *Tuberculin or Montoux test* :— It is done to find out whether any particular person had any previous tuberculous infection or not. Sufficient quantity of Tuberculin Solution (5 Tuberculin units) is administered intradermally into the skin of the left forearm on its anterior aspect so as to raise a wheal of about 7 m.m, in diameter. This site is examined after 72 hours. The test is considered positive if there is local redness and induration, measuring 6 m.m. or more in diameter. The person with positive reaction does not need BCG vaccination. But if there is no reaction or there is redness or induration measuring less than 6 m.m. in diameter, it is considered as negative reaction and BCG vaccination is therefore administered.

2. *BCG Vaccination* :—The injection is made intradermally into the skin of the arm just below the shoulder on usually the left side. Enough quantity is injected so as to make a wheal 8 m.m. in diameter. No general reaction, such as fever or pain follows nor is there any interruption in one's normal work. A "local reactien" occurs usually 3 or 4 weeks after the vaccination at the site of injection which consists in the formation of a small nodule and in some cases a small ulcer may follow which heals itself leaving a tiny scar.

It may be mentioned here that if a child is vaccinated at birth, there is no need of performing the Montoux test. Vaccination is however repeated subsequently at the age of 5, 10, and 15 years after performing montoux test.

Preparation of Tuberculin and BCG Vaccine :—Both the Tuberculin and BCG vaccines are prepared under the strict control of the Government at King's Institute Laboratory at

Guindy, Madras. The standard of BCG vaccine is certified by a W.H.O. expert, who periodically inspects the laboratory.

Precautions to be carried out in BCG vaccination technique are :—1. All strict aseptic precautions in handling the material, syringes, etc.

2. Both the tuberculin and vaccine are to be kept at a low temperature in an ice box or a refrigerator.

3. Fresh tuberculin and vaccine are to be used. Weekly supply is to be received from Guindy, Madras. The stock of vaccine must be consumed within a week and tuberculin within a fortnight after which their potency gets deteriorated.

4. Separate syringes are to be used for tuberculin test and BCG vaccination.

It may be noted that BGG vaccination is carried out in persons upto 20 years of age.

(*h*) Provision should be made by health authorities for thorough disinfection of houses where deaths from tuberculosis have occurred as well as for the disinfection of the other articles of the room.

(*i*) Individual measures :—1. The patient should not spit anywhere. He should spit in a sputum cup containing some disinfectant. When he is going about he should spit in his hand kerchief which may be boiled afterwards.

2. When coughing, he should keep the handkerchief before his mouth.

3. If he is married, he should live singly and, if not, he is advised not to marry.

(*j*) *Contacts* :—1. Contacts should visit the tuberculosis dispensary and get themselves thoroughly examined.

2. They should live under hygienic conditions.

3. A diet consisting of fatty food or cod liver oil is excellent.

Prevention of Bovine Tuberculosis :—The following measures should be adopted. 1. All dairies where cattle are kept should be registered.

2. Periodical tuberculin test should be done by a qualified veterinary surgeon. Isolation and destruction of cattle who happen to be suffering from tuberculosis should be done. Partial compensation may be paid to the owner.

3. Isolation of new-born calves to tuberculin free herds.

4. Prevention of export of diseased meat and tuberculin positive cattle. The meat of tubercular animals is very poor in quality.

Treatment :—1. The fundamental treatment is fresh air, complete rest and rich diet with abundance of milk, fruits, eggs, soft meat and fish.

2. Streptomycin one gram in 2 c.c. of double distilled water intramuscularly daily for 2½ months. Watch for early signs of deafness, in which case the administration should be discontinued.

P.A.S. (Paro-amino-salicylic acid) by mouth, three tablets of 5 grs. each, six times a day must be given simultaneously with streptomycin. It may upset digestion. It should be given for 3 months.

I.N.H. (Isonicotinic acid hydrozide) called Isoniazid 100 mg. twice a day is given by mouth.

Calcium, Vitamin A and D (Adexolin, Halibut oil, Cod liver oil) should be given.

3. Symptomatic treatment such as Serolin, Elixir Neogadine or Codiene for cough, inhalations etc. should be given.

4. Surgical treatment combined with antibiotics is the modern practice. Artificial Pneumothorax and collapse of the lung is done in suitable cases. Thorocoplasty is done for more extensive cases. Adhesions may require division.

BERI BERI

It is a disease caused by the deficiency of vitamin B_1 or thiamine in diet, which is said to neutralise certain poisonous substances which are produced during metabolism of carbohydrates. The amount of thiamine needed varies directly with the amount of carbohydrate metabolised, so that too much carbohydrate and too little thiamine plays a part in causing Beri Beri .

Occurrence :—It occurs among rice eating races, due to prolonged eating of polished rice. The outer layer of rice contains anti-Beri Beri Vitamin, which is absent in polished rice.

Types of Beri-Beri :—

1. *Very mild beri beri* :—Weakness and numbness of legs with diminished knee jerks, polyneuritis. etc.
2. *Chronic dry beri beri* :—The above symptoms get more pronounced. There may be foot drop, wrist drop and the patient is bedridden.
3. *Wet or dropsical type* :—Appearance of oedema is a special feature along with symptoms like dry beri beri.
4. *Acute cardiac beri beri* —Dilatation of heart or failure of heart during an attack of wet beri beri.
5. *Infantile beri beri* :—It occurs in infants of mothers suffering from beri beri.

Prevention :—It disappears if the use of polished or over milled rice is abandoned and whole rice substituted. The rice should be either home-pounded or of the parboiled milled type. Wholemeal bread may be used. Taking of canned foods should be avoided. Diets containing thiamine should be given or adequate doses of thiamine be given intravenously. Such substances like marmite or yeast extract or ground nuts rich in antineuritic vitamin should be freely given.

RABIES

Rabies is an acute infectious disease communicated from a rabid animal to a susceptible animal usually through a wound produced by biting or even licking of a rabid animal on an abraded surface. It is a virus disease and the infection is localised in the nervous system and the salivary glands. When it affects man, the most characteristic symptom produced is *hydrophobia i.e.* fear of water. This is not found in dogs or other animals. Temperature is raised, pulse is more frequent and saliva runs from the mouth. He becomes maniacal and dies after 2-4 days. He is infective during this stage. It is fatal and there is no treatment of hydrophobia.

Etiology :—The causal agent of rabies is not yet known. It is a ultra-microscopic and filterable virus and occurs in saliva, central nervous system and medulla of an infected animal. In the nerve cells of central nervous system, negri bodies are seen histologically which greatly vary in size; their diameter vary from 5 to 20 microns. All mammals are susceptible to rabies but the disease is contracted by man from animals, through the bite of a mad dog or a wild jackal. Rabies is a wound infection.

Once the animal gets infected with the disease, he rarely lives more than 10 days. The disease is rapidly fatal.

Incubation period :—It is extremely variable.

Average in man	40 days
Average in dog	21 to 90 days.

Symptoms generally appear between the period of 4 and 8 weeks after the bite. The incubation period depends upon :—

1. Site of the wound and its distance from the brain.
2. Relation of wound to nerves.
3. Degree of virulence of the virus.
4. Vitality of the person.
5. Depth of the wound, the number of bites, the species of biting animals and intervention of clothing etc., are the main factors which influence the risk of infection.

Prophylactic treatment :—This may be considered under the following heads :—1. *Immediate treatment of the wound* :—The wound should be washed, dried and then carefully cauterised as soon as possible with carbolic acid. If necessary, the wound should be enlarged. The acid should be applied with a glass-rod, care being taken that pockets and recesses do not escape. If acid is not available potassinm permanganate crystals, pure nitric acid, silver nitrate or iodine may be used.

2. *Pasteur's prophylatic treatment* :—After the wound is cauterised, the question of giving pasteur's treatment is considered. The physician is guided by the following facts : – (*a*) *The dog is dead and it is considered to be rabid*: —All persons who are bitten or licked on definite cuts or abrasions by that dog should receive treatment.

(*b*) *The dog is dead and it is suspected to be rabid* :—The brain of the suspected animal be examined in a laboratory for the presence of *negri bodies or inclusion bodies*. If they are found, the person must get treatment. Little reliance should be placed if the microscopical test is negative.

(*c*) *The dog has run away after biting* :—In case of unprovoked attack one should assume that the dog is rabid and the patient should get treatment.

(*d*) *The dog is alive* :—The dog should not be killed. If it dies within a short period, say two or three days, it should be presumed that it was rabid. If it lives more than ten days then it means that it was not rabid and the patient does not, need any treatment.

This treatment should be started as early as possible as once the symptoms develop, the disease is fatal and nothing can be done.

The following guide for specific postexposure treatment of Rabies has been adopted from World Health Organization Technical Report Series 1957, No. 121.

Nature of Exposure	Condition of biting animal		Recommended treatment (in addition to local treatment)
	At the time of Exposure	During observation period of 10 days	
1. No lesions; indirect contact only.	Rabid	—	None
2. Licks :— (*a*) Unabraded skin.	Rabid	—	None

Nature of Exposure	Condition of biting animal		Recommended treatment (in addition to local treatment)
	At the time of Exposure	During observation period of 10 days	
(*b*) Abraded skin and abraded or unabraded mucosa.	(*a*) Healthy	Healthy	None
	(*b*) Healthy	Clinical signs of rabies or proven rabid	Start vaccine at first signs of rabies in the animal.
	(*c*) Signs suggestive of rabies.	Healthy	Start vaccine immediately ; stop treatment if animal is normal on 5th day after exposure.
	(*d*) Rabid, escaped, killed or unknown.	—	Start vaccine immediately.
3. Bites :— (*a*) Mild exposure	(*a*) Healthy	Healthy	None
	(*b*) Healthy	Clinical signs of rabies or proven rabid	Start vaccine at first signs of rabies in the animal.
	(*c*) Signs suggestive of rabies.	Healthy	Start vaccine immediately ; stop treatment if animal is normal on 5th day after exposure.
	(*d*) Rabid, escaped, killed or unknown, or any bite by wolf, jackal, fox, bat or other wild animal.	—	Start vaccine immediately.

Nature of Exposure	Condition of biting animal		Recommended treatment (in addition to local treatment)
	At the time of Expenditure	During observation period of 10 days	
(*b*) Severe exposure (multiple; or face, head or neck bites)	(*a*) Healthy	Healthy	Hyper immune serum immediately; no vaccine as long as animal remains normal.
	(*b*) Healthy	Clinical signs of rabies or proven rabid	Hyperimmune serum immediately; start vaccine at first sign of rabies.
	(*c*) Signs suggestive of rabies	Healthy	Hyperimmune serum immediately, followed by vaccine; vaccine may be stopped if animal is normal on 5th day after exposure.
	(*d*) Rabid, escaped, killed or unknown. Any bite by wild animal.	—	Hyper immune serum immediately, followed by vaccine.

Note :—Hyperimmune serum is most effective when given within 72 hours of exposure, but there is no time limit as to when the serum may be given. Dose 0.5 c.c. per kgm. of body weight.

Pasteur's Antirabic Kasauli Vaccine :—The virus which is the cause of rabies is known as street virus. "A fixed virus" is prepared from the street virus after its passage through a series of brains of animals. When the time elapsing between infection and the death of the animal is not decreased further but remains constant, the virus is called fixed.

In Kasauli, sheep are used. They are injected and killed. The brain is removed, 80% brain emulsion is prepared and incubated. It is reduced to 5%. After sterility test, it is filled into 10, 5 and 2 c.c. ampoules.

Dose of antirabic vaccine :—1. For licks and scratches on intact skin and mucous membrane :—2 c.c. daily for 7 days.

2. For licks on wounds and deep scratches :—5 c.c. daily for 14 days.

3. For licks and scratches on head, face, neck and bites, over the body drawing blood :—10 c.c. daily for 14 days for adults, 5 c.c. daily for 14 days for children.

The vaccine is injected into loose subcutaneous tissues of abdomen. Tincture iodine is used to sterilise skin.

Diagnosis of rabies in dogs :—The course of the disease may be divided into 3 stages :—*1. Premonitary stage* :—There is a change in disposition of the animal. It is easily excited.

2. Stage of excitement :—It is restless and may become furious and even show signs of delirium. It rushes about attacking every object and dogs, biting and inoculating men and animals. It runs straight.

3. Stage of paralysis :—It soon sets in, first starting in the hind limbs and then becoming general. The course of the disease is always rapid.

If all these stages are noticed, then it is a case of *furious* rabies. If the first two stages are transient or absent then it is a *dumb or paralytic* rabies. Death occurs in 2 to 3 days. Presence of negri bodies in the brain of a rabid dog is the most important evidence so whole of the head packed in ice should be sent to the laboratory for examination,

Control of rabies in dogs :—It consists of :—1.*Destruction of all ownerless, stray dogs* :—The following methods are used :—

(*i*) Use of lethal chambers.
(*ii*) Injection of magnesium sulphate solution in spinalcord of the dog
(*iii*) Shooting
(*iv*) 3 grs. strychnine tablet wrapped in a small quantity of *halwa*. This is an inhuman way of killing dogs and should be discouraged.

2. *Registration and licensing* of all pet dogs in a municipality or district board.

3. *Muzzling and restraint* of dogs during control campaign. Quarantine of all imported dogs.

4. *Compulsory notification* of all cases of rabies.

5. *Prophylactic treatment* of pet dogs with antirabic vaccine.

6. *Education* of the public regarding rabies and its prevention and launching of publicity campaigns.

ANTHRAX

Anthrax is a disease caused by *Bacillus Anthracis*. It is primarily an epizootic of animals especially of sheep and cattle but transmissible to man. It is usually caught from working with infected animals or animal products. Human anthrax occurs in the following three forms :—(*a*) *Malignant Pustule* :—It occurs due to contamination of a cut or wound with anthrax micro-organism. This is common among butchers, farmers and veterinary surgeons and those employed in dealing with wool, hair, bristles and hides. The disease has also been contracted through infected shaving brushes, which have not been carefully sterilized.

(*b*) *Wool sorters' disease or pulmonary anthrax* .—It occurs due to aerial infection among the workers who inhale dust of threads from wool hairs or bristles which have been removed from infected animals, having spores of *Bacillus Anthracis*. It may be due to inhaling dust full of spores from the soil, which has been infected by an infected animal. The disease is mostly fatal.

(*c*) *Infection of the alimentary tracts* :—It occurs due to taking infected meat. This is rare but generally fatal. The disease usually develops within four to seven days although some times it is known to develop within less than 24 hours. Diagnosis is generally made after laboratory discovery of the organisms in pus or body fluids.

Treatment :—Penicillin is quite effective if treatment is started early. Aureomycin is also helpful. Untreated anthrax is a serious disease and is fatal in the majority of cases.

Prevention :—The workers who deal in wool, bristles, hides and animal products should take the following precautions :—

1. All workers should wear overalls and respirators. Gloves may be used, which must be disinfected after use.

2. No one with a cut or abrasion on his body should be allowed to work and all workers should wash themselves thoroughly before taking meals.

3. The bales of wool, bristles, hides etc., particularly those received from countries where the disease is common should be soaked in water, and disinfected by saturated steam or boiling for half an hour or by a suitable powerful disinfectant, before handling.

4. Mechanical exhausts should be provided beneath the sorting benches for the removal of dust.

5. Dust and sweepings should be destroyed by burning.

6. The floor of the sorting room should be impermeable and washed regularly with a suitable disinfectant.

7. All manipulations should be carried out through machinery.

8. Anthrax in man can be best prevented by controlling the disease among animals. Prompt diagnosis and slaughtering of affected animals has rendered the disease rare in some countries. The bodies of animals which have died of anthrax should be buried deeply in a pit 6 to 7 feet in depth, after plugging all the natural openings of the animal with a tow saturated with disinfectant, surrounded by quicklime, and no post-mortem examination should be made as the blood contains large number of bacilli which when exposed to air produce spores. It is still better to burn the animal, if sufficient fuel is available.

9. Shaving brushes should be thoroughly disinfected before sending to market. They should not be used, if they happen to be of unknown origin.

MALTA FEVER OR UNDULENT FEVER

The causative organism is *micrococcus melitensis*. It is a disease with long pyrexial periods, many relapses, very varied features and a few deaths. There are three types of causative organisms, those affecting goats, pigs and cows, all of which can cause human disease.

Malta or Mediterranian fever is usually contracted as a result of drinking infected milk of goats suffering from chronic form of disease in which the health of the animal is little affected. It may also be conveyed to man, by contact with the animal as happens in the case of goat herds. It very rarely spreads from man to man.

Its incubation period is about 14 days.

Prevention :—The following measures should be adopted:—

1. Diagnose the disease in animals. The infected animals should be isolated and treated or slaughtered, to stamp out the disease.

2. Boiling or pasteurisation of all milk especially goats-milk, before use. It should not be taken raw.

FOOT AND MOUTH DISEASE

It is an acute and highly communicable disease of cloven-footed animals and is characterised by an eruption of vesicles on the mucous membrane of the mouth and on the skin between the toes and above the hoofs, some time on udders or other parts of the body.

It is a virus disease and is transmitted to man through the ingestion of raw milk and milk products derived from animals suffering from foot and mouth disease and rarely may become infected through contact with affected parts by milking, slaughtering, and looking after the animals. The disease is mild in man and is rarely fatal.

Prevention :—This is as follows :—1. In countries where the disease does not exist, all imported cattle must be kept in quarantine.

2. Suppression of the disease in animals by isolation, slaughtering and disinfection.

3. Individual protection should be carried out by disinfection and pasteurisation of milk.

GLANDERS

Glanders is a wide-spread communicable disease of horses, mules, asses and other animals. Cattle are immune. It is caused by *Bacillus mallei* which is non-spore bearing. It is readily communicable to man and is characterised by the occurrence either in nasal mucous membrane or the skin of the inflammatory nodules which break down forming ulcers. The mortality is about 50%. It occurs both as an acute and in chronic forms.

Prevention :—It is done by eradication of the disease in animals. This is carried out by early diagnosis by the mallein and serological tests, isolation, slaughtering and disinfection. The personal prophylaxis of glanders in man depends upon education and care of those who have to handle horses. Rubber gloves may be used when handling infected horses.

LEPROSY

It is a chronic communicable disease, characterised by lesions of the skin and by involvement of perepheral nerves with consequent anaesthesia, muscle weakness and paralysis and trophic changes in skin, muscles and bones.

Leprosy is caused by *mycobacterium leprae* and was discovered by a Norweigian leprologist named Armaur Hansen in purulent discharges from nose, ulcers, etc. The disease develops slowly and after a long exposure. Chilrden are more susceptible than adults.

Varieties :—There are two varieties :—1. *Neural or anaesthetic* :—It is benign and resistant. The peripheral nerves are affected. The patient lives comparatively longer.

2. *Nodular or tubercular* :—The patient lives from 8 to 10 years on an average.

Signs of leprosy :—1st stage :—There is an appearance of a small patch on the skin. It has less sensation than the surrounding skin. There is a thickening of the ulnar nerve, and feeling of tingling sensation when nerves are pressed. The patient is seldom infectious.

2nd stage :—Skin of the face becomes thick and wrinkled, ears are swollen and the skin of the whole body is thickened and covered with nodules. The nodules affect the nose and throat which consequently discharge a fluid containing lepra bacilli. This stage is infectious and lepra bacilli are passed even in urine and faeces.

3rd stage :—In this stage there are very few lepra bacilli and the patient is much less dangerous. Patient develops deformities of hands and feet. The fingers and toes become bent, ulcerated or drop and disappear altogether. The patient is sometimes unable to shut his eyelids. There may be foot drop. This is the most painful and loathsome stage of the diseasc and it is difficult to do anything at this stage.

Leprous or lepra reaction :—This is observed during treatment and is specially marked in second stage. When it occurs, the diseased part *i.e.*, patches and nodules swell up suddenly and become red, the patient may develop fever which may reach 104 °F and he appears to be very much worse. The leprous reaction may continue for 10—14 days. Some patients appear to have improved following a reaction, while others may get worse. There may be one reaction after another for many months.

Methods of spread :—They are:—1. Aerial :—Coughing and sneezing by the infected person.

2, Fomites :—Clothing, handkerchiefs etc., used by infected persons.

3. From person to person :—Prolonged exposure or close contact is necessary before infection takes place.

4. Indirect :—Flies may carry bacilli from ulcers and discharges. Bed bugs have been found to harbour the bacilli and are capable of transmitting the disease in animals.

Leprosy cases can be divided into lepromatous and non-lepromatous ones from control point of view, Lepromatous cases are infectious.

Prevention :—1. Compulsory notification.

2. Isolation and segregation of infectious cases in their own homes, hospitals and institutions.

The institutions are:—(a) Leprosaria :—They are for the able bodied non-crippled and controlled leprosy cases where they can earn their livelihood by agriculture or poultry farming etc.

(b) Hospitals :—They are for treating open infectious cases.

(c) Leperhomes and asylums :—They are meant for crippled patients.

3. The beddings and cooking utensils of the patients should be kept apart and they should be soaked in a disinfectant solution.

4. Lepers should not be allowed to go in the streets, to keep shops or handle food or wander about in the country as beggars, padlars or mendicants. Their discharges, clothes and dressings should be destroyed or thoroughly disinfected,

5. Indiscriminate alms giving to lepars is wasteful and must be avoided as it attracts lepars to big cities, religious places, fairs etc., and so encourages the spread of infection.

6. They should be treated with newer sulphone groups or with chaulmogra oil, hydnocarpate of sodium and morrhuate of sodium.

TRACHOMA

Trachoma is a contagious follicular conjunctivitis with characteristic "Sago" granulations. It is generally preceded by some other abnormal eye condition following the acute state of granulation ; there is a chronic state of cicatrisation as a result of which the lids may become deformed. The disease is serious because it may lead to scarring of the eye tissues and eventual blindness.

It is caused by a virus that invades the mucous membrane covering the surface of the eyeball and the lining of the lids.

The disease may be spread by personal contact or through the handling of towels, handkerchiefs and other linen which has been handled by a person suffering from the disease.

The spread of trachoma is favoured by malnutrition, over crowding and inadequate personal cleanliness.

Good results are now reported to follow the administration of sulphanilamide both orally and as a saturated solution applied to the lesion. Deformity of the eyelids require surgical treatment. Attention should be paid to personal hygiene.

VENEREAL DISEASES

They generally include syphilis, gonorrhoea and chancroid or soft sore and granuloma inguinale (venereum), which are all

important from the public health point of view. They are responsible for : —(a) 35% of all insanity ; (b) 40% of mentally defectives ; (c) 40-60% of blindness ; (d) 50% of sterility ; (e) 30-40% of abortions and miscarriages ; (f) High percentage of diseases of heart, blood vessels and the nervous system.

Syphilis :—It is quite common throughout the world but in Western countries it has been lowered to a great extent. It is caused by *spirocheta or treponema pallidum* which pass through cracks in skin or mucous membrane. The entry occurs directly during sexual intercourse or congenitally by foetus in utero. Primary sore may also be formed on the mouth or lips after kissing an infected part. Indirectly, it may be caused by use of infected articles such as clothes, towels, cups, pipes etc., but it is rare.

Incubation period :—It varies from 10 days to 10 weeks. Average is about a month.

Types of Syphilis :—Acquired and congential.

Acquired Syphilis :—Usually adults and elderly persons get it from sexual contact and children get from contacts or use of infected towels. After the incubation period, the person passes through 3 stages.

1. *Early Syphilis* .—(*a*) *Primary stage* :—There is appearance of a hard sore called chancre on genitals, which is single, painless and there is no discharge. This chancre if left, heals up leaving behind a scar which is important in diagnosis.

(*b*) *Secondary Stage* : —It occurs from 6 weeks to 6 months after infection. Enlarged glands, sore throat, condylomata, loss of voice and loss of hair are seen in it. Purple coloured rash appears all over body which has no itching sensation.

2. *Late Syphilis i.e.* any, manifestation occurring 5 years after infection. Heart, arteries and central nervous system are affected. Gumma, a chronic granulomatous lesion of the internal organs appear which is not painful and tender. Leukoplakia of the tongue and buccal mucous membrane is a fairly common manifestation. The organisms cause degeneration of nerve cells and results in the paralysis of the Insane or Tabes Dorsalis. Syphilis leads to abortion in pregnancy and congenital syphilis if the child is born alive.

3. *Congenital Syphilis* :—A mother of congenital syphilitic child gives the history of abortion or still birth of 2 or 3 children in 3rd, 6th and 7th months of pregnancy respectively. The third or fourth child who was born alive, had secondary syphilitic characteristics like Hutchinson's teeth, bridged nose, prominent

head, snail tract or small chin like sign on palate and other signs like defects of eyes, ears, anterior fontanella palpitating etc.

Treatment :—In early syphilis 800,000 units of procaine penicillin are given daily for 7 days. Arsenic preparations e.g. N.A.B. (Neo-Arsphenamine in the divided doses of 0.15 gm.—2 injections, 0.3 gm. and 0.45 gm.—4 injections and 0.6 gm.—3 injections twice a week, intravenously on empty stomach, dissolved in 3—5 c.c. of redistilled water.

Bismuth Preparations :—Bismutab—1 c.c. intramuscularly twice a week.

In late syphilis :—Potassium iodide by mouth and bismuth, and arsenic by injections are administered and this is also combined with penicillin therapy.

Gonorrhoea :—It is an acute infectious disease characterised by inflammation of the urethra, painful micturition, purulent discharge and a liability to certain complications such as ophthalmia, endocarditis and arthritis. It is caused by *neisseria gonococcus* discovered first by Neisser in 1879 which is a gram negative diplococcus. It is contracted by sexual intercourse. In majority of cases, it may be caused indirectly by infected towels, bed, clothes etc.

Incubation period :— It is 3 days to 3 weeks. Average is within one week.

Symptoms :—They are enlarged painful lymph glands, pus from urethra, painful micturition and difficulty in walking. If not treated, it leads to a chronic stage.

Among its sequelae in males are urethral strictures and in females sterility. In new-born babies ophthalmia neonatorum is caused during the passage of baby through the vaginal canal of mother suffering from gonorrhoea. It may lead to blindness.

Treatment :—Procaine penicillin 400,000 units is given daily for 4 days in acute cases and surgical interference is done in chronic cases.

1. Sulphadiazine—1.5 gm. four times a day for 5 days.
2. Alkaline mixture as alkacitron.
3. Nonirritating bland diet.
4. In chronic urethral stricture, sounding may be helpful.

Soft chancre :—It is localised and may heal spontaneously but vaccine of *ducrey bacillus* will hasten recovery, and sulphanilimide is also used as a remedy.

Control of Venereal Diseases :—The following measures should be adopted :—

1. The public should be educated regarding the danger of venereal diseases, methods of disinfection and use of prophylactic methods through lectures, films, posters, etc. It should be impressed upon the public that they should lead a clean life and not indulge in illicit sexual intercourse, as besides being morally wrong, there is a grave risk of contracting venereal diseases by such acts. Education be given on sex hygiene.

2. *Venereal Diseases Clinics* :—They should be established for prompt and expert diagnosis and curative treatment. All information regaring patients should be treated as a professional secret. The clinic should be held at hours which suit the convenience of patients. All possible privacy should be maintained, in dealing with cases. Clinics for male and female patients should be separate. In addition, such female clinics should be attached to maternity and child welfare centres. These clinics should be free. Midwives and dais should be imparted training in the routine methods for the prevention of ophthalmia neonatorum

3. *Medicinal prophylaxis* :—(a) For syphilis :—Use condom. Wash genitalia thoroughly with soap and water or antiseptics like potassium permanganate or silver nitrate lotion and rub 30% calomal ointment. Sometimes arsenic or bismuth preparations are also tried.

(b) For gonorrhoea :—Use condom, urethral injection of 2% protargol, or give 10% argyrol, retaining the medicine for 5 minutes by holding meatus firmly. Irrigation with weak potassium permanganate solution or sulpha drugs may also be tried with advantage.

4. *State administrative measures* :—(a) Suppression of prostitution if possible.

(b) Periodical inspection of prostitutes and treatment of infected ones.

(c) Registration of brothel houses and prostitutes.

(d) Prohibition by Legislation of the treatment of venereal diseases by quacks.

(e) Training in routine methods of midwives and dais for prevention of ophthalmia neonatorum.

(f) Arrangement of special courses of venereology for medical men and medical students.

TETANUS

Tetanus or lock-jaw, may follow a wound when dirt is carried into the tissues especially if the dirt is around barns or from road. The chief wounds which give rise to it are deep-

stabs or penetrating wounds or those, with much contusion or wounds received on roads, gardens or on agricultural lands.

The tetanus bacilli are commonly found in the intestinal tract of horses and cattle. They are anaerobic and spore producing, generally remaining in soil, dust or dirt. The incubation period is 5 to 10 days ; with spasm of the glottis, asphyxia, heart failure or exhaustion.

The most common symptom of the disease is a painful spasm (contraction) of the back muscles, bending the body back on spine resembling a bow and of the jaw muscles. This accounts for the common name "Lock-Jaw."

The first symptoms of tetanus usually appear from 3 days to 3 weeks, after the infection finds access into the wound. The first indications of trouble are irritability and restlessness together with headache and occasional chills. Gradually the neck becomes stiff and there is difficulty in chewing and swallowing. Subsequently spasms of muscles of the jaw and face take place and thus "Lock Jaw" occurs. The temperature in the early stages ranges from 100 °F to 105 °F or even higher. There is severe pain and a large percentage of the cases die after a few days. The patient should be kept in a dark and calm room free from noise.

The specific remedy is tetanus antitoxin prepared by immunising horses, with toxin of the *clostridium tetani*. The dosage required is high upto 200,000 units given intramuscularly. It is aided by intrathecal administration of magnesium sulphate and irrigation of wound with hydrogen peroxide. Sedatives are required for spasms.

Prevention :—All wounds should be treated carefully especially if there is a question of contamination with refuse from stables. They should be thoroughly cleaned and 3% iodine solution should be applied. Two injections of toxoid each of 1.0 c.c. should be administered with an interval of six weeks. A year later, a third injection of same amount is to be given. This method is much utilised in the army.

Any doctor, who treats a wounded person soon after the infliction of wound should be considered grossly ignorant or negligent if he omits to take necessary preventive measures in consequence of which his patient develops tetanus.

RINGWORM (TINEA)

This is an affection of skin caused by a sporing fungus which penetrates into hair follicles and destroys hairs; these break off leaving stumps scattered over ring shaped scaly patches which soon become yellow and crusted. There are different

types of the fungus affecting the scalp, body, beard area, nails and also the skin of animals. The affected hairs are highly infectious, since they are loaded with innumerable spores.

Treatment of ringworm of scalp :—

1. *Epilation* :—The hair must be made to fall out since it is otherwise impossible to reach the roots in order to kill the fungus. First the hair is cut short all over the scalp and then made to fall out either by :—

(a) X'ray exposures.

(b) Thallium acetate given by mouth.

2. *Treatment of the scalp* : It should be washed every day and usually either painting with tincture of Iodine or application of disinfectant ointment is ordered, since the new hairs growing up push out the infected stumps from follicles. Washable caps are worn.

3. *Isolation and Disinfection* :—The child is isolated from others and every thing which it uses or plays with, is kept separate. Hats, brushes, combs and toilet articles should be destroyed since it is impossible to free them from spores; linen should be soaked in 1 in 20 or boiled before being sent to the laundry; all articles not boiled or destroyed should be steam sterilised.

CHAPTER XVI

RURAL OR VILLAGE SANITATION

About 82% of people in India live in the villages. So the country is rural and it can not make sound progress unless the rural conditions are improved.

In these days, the question of improving the sanitation in villages is engaging much attention of both the people and the Government.

Any scheme for the improvement of sanitation in villages should deal with the following points :—

1. **Mass education** :—Villagers are ignorant, particularly on health matters. They should be given the knowledge of health and healthy living. They should be convinced that most of the diseases from which they suffer are preventable and thousands of lives could be saved annually by observing proper precautions. The dangers of insanitary habits, overcrowding, effects of ill-ventilation, unhygienic surrounding and pollution of water-supply should be impressed upon them. This can be best done through lantern slides, lectures, films, posters, pamphlets in different languages, etc. A primer in simple language for imparting knowledge on hygiene and preventable diseases should be introduced in village schools.

2. **Rural town planning** :—In the majority of cases villages have been developed in a haphazard manner. There is no plan or design. There is nobody to guide the villagers. The houses are built to suit the personal convenience of owners and on the advice of a village mason. Cattle and other domestic animals are kept in the same room where food is stored or cooked. The Government should construct some model villages and provide some agency for giving advice to the villagers on the planning of villages and construction of houses. In future there should be a planned construction of each and every house in the village. It should be built on a plinth having a height of at least 1 ft. and each of the rooms should be at least 15 ft. x 12 ft. with 12 ft. height. Each house should contain at least two rooms, a kitchen, a bath room, a courtyard and a verandah. The rooms should be provided with windows and ventilators. The floors should be made of bricks or some other impermeable material. If a privy is to be also constructed in the house it should be situated in the courtyard away from the living rooms and kitchen.

3. Water supply :—Provision for pure water supply for drinking and cooking purposes is the most important problem in villages.

Model deep wells or tube wells should be provided and they should be guarded against all possible sources of pollution. In some places model tanks are provided. They should also be supervised on similar lines. Wherever possible the pumps should be provided to wells and tanks for drawing water. If this is not possible a metal bucket or a chain may be used. In no case steps should be provided in the wells as the danger of water getting polluted therefrom is considerably enhanced and this polluted water may prove to be a potent source of guinea worm infection. Regular disinfection by bleaching powder should be carried out, particularly during cholera season.

4. Conservancy :—There are practically no arrangements in the villages for privies or latrines and consequently, the villagers generally go to some open land or fields or use banks of tanks, canals or rivers for purposes of answering the call of nature, thus giving rise to dangers of pollution of soil and water with human excreta and spreading hookworm infection and other filth diseases.

Arrangement should be made for privies in every house. If this is not possible, public latrines should be provided at suitable places and the people induced to use them. Borehole latrines or dugwell latrines are very useful and are therefore especially advocated. Trench latrines are quite useful and inexpensive. Moreover children should not be allowed to ease themselves anywhere and everywhere in the house.

Disposal of dry refuse is very important. This consists of refuse from stables, cowdung, food wastes, dust etc. This is used by the villagers as a manure in their fields. Proper manure pits should be provided at a suitable distance from their residential houses. The refuse should be covered with earth so that the flies may not breed in them which should then be removed to the fields in due course of time.

Incineration of the refuse is also suggested, particularly when it is mixed with nightsoil as its disposal becomes more sanitary when subjected to incineration.

The removal of waste water, rain water and other liquid wastes is generally effected through surface drains. They should be made pucca with a proper gradient and should be cleaned periodically. Arrangements should be made for utilising this water for irrigation purposes over agricultural land.

5. Disposal of dead bodies :- Suitable separate places should be fixed for the disposal of dead bodies of men and ani-

mals, where they may not be a source of nuisance to the residents of that village.

6. **Measures against preventable diseases :—** Arrangements should be made for providing prophylactic as well as curative measures against preventable diseases. There should be treatment centres or dispensaries provided in villages, in the ratio of one for every 20.000 persons. If that is not possible or if it is a small village, then a travelling dispensary under the charge of a qualified medical officer will serve as a useful purpose in giving medical relief and prophylactic inoculation during epidemics to the villagers. Arrangements should be made for anti malaria and maternity child welfare work. Travelling dispensaries may also serve useful purpose in distributing drugs etc., to the poor in the villages in the case of emergency. At least trained dais should be available in villages. Village women should be encouraged to settle in rural areas after training. If possible a lady health visitor should be employed for a group of villages to look after maternity and child welfare work. Systematic vaccination and revaccination arrangements should exist for the prevention of smallpox in villages.

7. **Proper supervision of articles of food and drink :—** Particularly at the time of outbreak of epidemics the villagers should protect their food stuffs from dust and flies. Milk should be boiled. Villagers should be advised to take boiled water during epidemics. The water of tanks and wells should be sterilised by means of bleaching powder. Washermen should not be allowed to wash dirty and infected clothes in the tank or well water used for drinking purposes.

CHAPTER XVII

SANITATION AT FAIRS AND FESTIVALS

Many a time fairs and other festivals have been a source of outbreak of epidemic diseases, chiefly cholera. So it is very essential that arrangements should be made for their successful control beforehand. For carrying on these measures some person or persons should be made responsible for the organisation of the fair. There should be appointed also a medical officer of health with executive powers who should be put in charge of the sanitary arrangements. Adequate funds will be needed by him to make himself effective.

For efficient control of epidemics during these fairs the following points should be attended to :—**1. Planning of the arrangements** :—The organisers of the fair along with the medical officer of health and other members of the advisory committee should chalk out a plan. It is for them to see that the ground is cleared of all vegetations, levelled and demarcated into different blocks with well-planned roads. The layout plan should be fixed, at a prominent place for the information of the public. In fact long before the opening of the mela the pilgrims should be advised through posters and newspaper advertisements of their obligations vis-a-vis the arrangements made.

2. Accommodation :—This is to be provided to the organisers, police, health and medical authorities in the first instance. For the pilgrims, residential blocks along with sanitary conveniences should be arranged. The land selected should have natural drainage and should be well-shaded and watered. If there are any depressions, cesspits or pools they should be filled up. The main road approaching the mela ground should be metalled or otherwise made smooth and firm.

3. Medical and sanitary arrangements :—The fair should be under the charge of a medical officer of health and the whole area should be divided into blocks placed under the charge of sanitary inspectors. Moreover, accommodation should be provided for infectious diseases' cases where patients should be removed on stretchers. Adequate quantity of disinfectants should be provided. Temporary hospitals and dispensaries, with qualified doctors, should be arranged for the treatment of sick persons.

4. Water supply :—Efficient arrangement for the supply of wholesome water should be made from any one or more of the following sources :—

(a) Filtered and chlorinated water from awater-works, which is very safe.
(b) Deep tube-wells.
(c) Wells.
(d) Galvanised iron cisterns.

All these sources should be thoroughly disinfected beforehand so as to avoid the danger of an outbreak of any water-borne epidemic.

5. **Efficient Conservancy** :—Adequate whole time conservancy staff should be engaged for :—(a) Sweeping of the roads, residential blocks, etc.

(b) Cleaning of latrines, urinals or other sanitary conveniences.

Sweeping :—The roads should be properly swept and watered. One sweeper for every 2000 pilgrims is the standard aimed at. Covered dust bins should be placed at suitable sites in the mela ground for collection of rubbish and sweeping, from where they should be removed by carts or trucks to a place of disposal.

Latrines :—Suitable sites should be selected and different types of latrines constructed both for males and females separately. Trench latrines are recommended. Female sweepers should be employed for latrines meant for use by women. The number of seats of latrines aimed at is as under :—

1. 2 seats for 1000 people – if the fair is to last for one day.
2. One seat for 100 persons—if their stay is longer than a day.

Urinals :—Adequate number of urinals should be provided at suitable places all over the mela ground which should be separate for both sexes. In ordinary soil, a pit, four feet square and 5 feet deep, filled with broken bricks should be made and on each corner of this pit, a kerosene oil tin container full of saw dust with perforated bottom should be placed.

These latrines and urinals should be kept in a clean and sanitary condition and they should not be too far away, otherwise there is a likelihood that people will not use them. There should be proper lighting arrangement at night. Picture boards indicating the sex for which they are meant should be fixed near the entrance. Satisfactory arrangement for removal and disposal of refuse and night soil should be made. The refuse may be dumped and incinerated. In the later case Beehive pattern or an open incinerator may be more useful.

6. **Food supply** :—Strict supervision on the sale of food supply should be exercised. No unwholesome or stale articles of

food and drink, overripe fruits and decaying vegetables are to be allowed to enter the mela ground.

7. Inoculation against Cholera :—During mela days no person should be allowed to enter the mela ground unless he has had anticholera inoculation and possesses a certificate to that effect.

8. Provision of Inspection posts :—They are provided on the roads, before entry into mela grounds, where the staff is instructed to see that no person suffering from an infectious disease visits the mela ground. The certificates of anticholera inoculation are also checked by them.

9. Handling of Problem of Prostitutes :—Social workers should educate the public by propaganda regarding the evils of prostitution.

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CHAPTER XVIII

HEALTH EDUCATION

(By Dr. D. Anand M.P.H.)

Evolution of Health Education :—The era of modern medicine starts from the time of Hippocrates, who with his power of reasoning established hypothesis about occurrence of disease which are true even today. Thereafter in succession came the discovery of microscope and the ability of scientists to detect germs of various diseases. The discovory by Janner and Pasteur of the system of inoculation as a preventive measure opened a new chapter in the field of medicine. A steady progress has been maintained in the field of medicine to provide the maximum opportunity to lead a healthier and fuller life. But the number of people benefiting from the services available in a public health department today is far less than might be expected.

Another problem which faces the public health worker in every day life is the increasingly complex character of health problems which require wider and greater co-operation of the people in community health programmes. Looking back at history, we find that there was a time when public health measures had to be enforced (as at the time of threatened epidemics) without regard to the peoples' belief. This resulted in mass compliance by people who were ignorant of the advantages and who resented the action taken, even if they came to accept it because of the fear on the wrong side of law. Such mass activities seldom helped to change the habits of the people since time after time we had in the past repeated the same story of threatened epidemics, panic in the population, stern public health means supported by law, temporary acceptance by the people and finally return to the same old conditions of insanitary environments that breed disease. The progressive countries in the West, found an answer for removing the bottle neck by adopting the educational approach for all services offered by the health department.

People accept a programme or service only when they are convinced of its utility and do not find it at great variance with their culture and tradition. In order to use the educational approach, therefore, we need to be conversant with the sciences that take note of changes in social attitude and cultural patterns in a community. In other words the social sciences provide the basis for the principles underlying health education programmes.

What is health education? The question need to be answered in two different aspects *i.e.*, as a science taught in the school of public health and as a service provided by a health department :—(*a*) *As a science taught in school of public health* :— Health education means an understanding of the ways people learn and accept newer ways to live a healthier life. The subject also deals with problems of mass communication, media used for communication and the choice of media used in different situation.

(*b*) *As a service provided by a health department* :—Health education by itself has no specialized programme but forms an important and integral part of any public health programme, conservancy, environmental sanitation, nutrition, maternal and child care etc., so as to improve the efficacy of the service. The work done in a section of health education is more than education as the work of a health education is not confined to providing only knowledge or information on various aspects of health to an individual or a community. A health education programme has to create consciousness in the community about the prevailing health problems. The community organization should lead to utilization of the existing resources in the community for solving the health problems. The most difficult task that follows a community health programme is the maintenance of the initial force in respect to individuals so as to change individual behaviour that will lead to better health for the individual and the family. As a matter of fact, the work does not stop there, as an assessment of the work in terms of the objectives is another important part and so is also the follow up. It is not essential that health education should perform all these functions and services. As mentioned before, such a method and approach to work should form the basis of every field worker in the health department. If we apply the principles of health education to the work performed by a sanitary inspector in development programmes we will see that unknowingly, he has followed the educational approach so as to achieve the success in his developmental programmes, e.g. before initiating work on construction of drains and pavement of streets, he must have made the people conscious of the problem and also of the resources by way of funds available to help them in overcoming the existing problems. But how much did he make the individual conscious of his responsibility as a member of the society in the upkeep of the new construction and how much has the new construction helped an individual to change his habits? The answer to these two questions will indicate the ultimate success of any programme. An average field-worker might miss to take stock of the activities if he is unable to answer the above mention-

ed questions. He is also likely to miss because he has not been trained in the educational methods and techniques. The section of health education therefore aims to provide :—

(*a*) *With relation to health department* :—(*i*) Necessary aid in planning and implementation of the educational aspects of departmental programme.

(*ii*) To establish values and standards before launching a programme, so as to measure the success of various programmes.

(*b*) *With relation to the community* :—(*i*) Help to the community to recognize and define its health problems.

(*ii*) Help to the community to discover resources available for solving those problems.

(*iii*) Understanding that maintenance of the health of a community is a social responsibility requiring participation of all members of the community.

The ultimate goal of the section of health education should be to help in the establishment of a community which understands and practises sound health principles.

Underlying Principles to Health Education :—As has already been stated the study of social and cultural patterns that aids an individual to learn and act, form an important part of the educational approach. In the field of public health education, as distinguished from school health, we are concerned with the ways by means of which adults learn and act. Though still more research is needed to understand the hows and whys of learning, yet sufficient work has been done to indicate the factors concerned in the learning process. Briefly stated the following facts indicate the accepted principles:—All individuals are capable of learning throughout their lives.

2. In advancing age, the capacity for learning is not changed substantially but the desire to learn is affected due to lack of interest.

3. All individuals when exposed to a learning experience will not learn the same way, as their own outlook which covers the back-ground experience, will influence the learning situation, *e.g.* any one if told about the efficacy of anti-venum serum against snake-bite may not believe the fact if he comes from a family that believes in chanting of 'Mantras' for removing the effect of snake poison.

4. Learning to change habits and beliefs can only be brought about by an individual's own efforts, because learning is an active process and merely passing on of information to an individual will not make any one learn.

5. We all want to learn because we are always wanting to satisfy the basic human needs of survival, food, love and social approval.

6. People learn newer methods easily when they can under stand the objective and the goals for learning and are conversant with the means of achieving those objectives.

7. Any person when exposed to a new learning situation can only absorb something of it at a time and he should be allowed to digest the same.

Methods of Education :—For providing a learning experience for adults we employ either of the two following methods :—

1. *One way or lecture method* :—One person who may be an employee of the health department talks to the people about the health problems that may be uppermost in his mind and for which he feels the people should know something about it.

   He, in the course of his talk, might or might not use visual aids to supplement his talk. While such a learning experience might be of some benefit to the audience, it is likely to excite poor response for community action to solve health problems. This is because the talk did not provide sufficient opportunity for the people to express their views and hence their interest. The lecture or one way method employed by the speaker, only provided information without taking into consideration the peoples' reaction, experiences and desires.

2. *Two way learning process* :—Experts in social sciences are now of unanimous opinion that the two way learning process wherein, the audience participates in discussions, is the ideal method for initiating community action to solve a health problem. The two way learning process also known as the "*Socratic method*" assumes that people already possess information, feelings, interests and beliefs which profoundly affect the learning process. Discussions, committee meetings, council meetings, interviews etc. are the examples of the "Socratic method" of learning.

Methods employed in practice :—We employ a combination of these methods in our practice when we undertake :—

1. Interviews.
2. Talks and discussions.

1. Interviews :—The members of public health staff in the field, particularly the lady health visitors and the sanitary inspectors will use this as the most reliable and most effective

method for bringing home to the people the services offered by their department. The method is also helpful in bringing round those persons who offer resistance to any community health programme.

2. **Talks and discussions** :—The lecture method is commonly used for providing information to the public on the existing health problems or the services available to meet the same. It is a common experience that we learn very little from such lectures as people cannot concentrate in listening to a lecture for a long time. Also the effect that a lecture will produce will depend on the qualities of the speaker and the excellence of his performance. Even then the effect is likely to fade away after some time.

In order, therefore, to keep up the interest of the group and to provide a learning experience in which the audience can participate we undertake various other methods such a *panel* or *symposium* methods of discussion. These are form of lectures which break at suitable intervals to allow the participants to digest what all has been said and also to give their reactions about the topic under discussion.

Place of Audiovisual Aids in Educational Programme :— We have mentioned that adults have the capacity to learn but the desire to learn fades with the advancing age. Audiovisual aids help in the learning process by providing materials that hold our interest and thereby accentuate our desire to learn. But it must be remembered that these are merely aids to learning and do not replace the text or the subject itself. whereas through the utilization of more than one sensory channel, a teacher helps to properly understand the subject matter :—

Types of Audiovisual Aids :—There are various types of audiovisual aids that can be used from time to time depending on the need and the resources available. The following list does not cover any special order of priority.

Black-board and Bulletin-board.
Charts : table, flow, organization.
Drama : puppet show, pageant.
Graphs : —Pictorial, bar, area, line.
Maps : flat, relief, electric, globe.
Models : objects. specimens.
Motion pictures.
Pictures : photographs, prints.
Posters.
Radio programmes.
Projected pictures : slides, film strips.
Demonstration tours.

Care and Utilization :—Very often in our endeavour to make nse of the audiovisual aids, we forget to take into account all those factors in relation to our programme or the community where we are working which are important for community organization. We must remember that audiovisual aids provoke a mental reaction which in many ways is similar to the reaction that is provoked in the body by the use of an immunizing vaccine. We are likely to injure and even kill a person if we use 10 times the normal dose of a vaccine. What holds good in relation to an individual and a large dose of vaccine also holds good in relation to an over-emphasis on use of visual aids in community programmes. We may completely fail to produce the effect that we intend to bring about. The following points must always be remembered for effective utilization of visual aids —1. Understanding of the power of each visual aid that is likely to be used in a community health programme.

2. A sense of proportion must always be developed. A restraining hand is necessary as we always tend to overemphasise the use of visual aids.

3. Clear understanding of the purpose of using aid. We must remember that :—(1) Visual aids are not an end in themselves but simply means to achieve an end. (2) A weak, ill planned programme cannot be made effective by use of visual aids. (3) Visual aids cannot replace the spoken or written words.

General principles governing the use of visual aids :—1. Effort must be made to select the material according to the needs of the subject and requirements of the participants.

2. No single type of aid is suitable for all groups.

3. Too much material used at any one time may cause more confusion than clarify the subject under discussion.

4. Advance preparation of visual material needed for display must be checked before final display.

5. The gathering must be made to participate in the discussion of the subject and hence the emphasis should be on community participation and not on use of visual aids.

On the whole, examples and demonstrations should be positive rather than negative. It avoids confusion and leads to a clear understanding of the problem.

The material should never be used haphazardly and the display should never be allowed to be merely entertainment unless the objective of the total programme is that and nothing more.

CHAPTER XX

PUBLIC HEALTH ADMINISTRATION

Health is mainly a state subject, but Central Ministry of Health exercises sole executive power in regard to the subjects in the union list and powers in relation to the subjects in the concurrant list. So far as the states are concerned the function of Mini stry of Health is purely advisory and of co-ordination. Besides, it supplies them with vital information on medical subjects and for this purpose maintains a close laison with foreign countries and international health organisations like World Health Organisation, United Nations International Emergency Fund, Rockfeller Foundation and Red Cross Society.

Ministry of Health :—With the advent of independence, a Ministry of Health has been established in the centre. The Ministry is directly responsible for the health of the centrally administered areas. The states are autonomous in respect of Medical Relief and Public Health. The centre, however advises and keeps in close touch with them in their endeavours to build up the health of the people, committed to their charge.

The Health Minister is an elected member from the public. He has a secretary and under-secretaries in his ministry.

The Central Ministry of Health comprises of the main Ministry and the Directorate General of Health Services which functions as an attached Office. The Central Directorate is under the charge of Director General of Heath Services who is assisted by Deputy and Assistant Directors General and advisors who deal with different branches.

State Health System of Administration :—The port folio of health is under an elected minister. He is assisted by a secretary to the Government. There is a Director of Health services who is an administrative officer and is incharge of medical education, medical and Public Health administration. He has a Deputy Director of Health (medical), Deputy Director of Health (Public health) and assistant Directors incharge of various sections. The Deputy Director of Health (medical) controls the curative side through the civil surgeons under whom are hospitals and dispensaries in the districts ; the Deputy Director of Health (Public Health) controls the preventive side through the District and Municipal medical officers of health. Duing the last few years there has been rapid expansion in both the curative and preventive sides. Public Health Insurance schemes are

being gradually introduced so that in a few years medical aid will be available to every individual on a payment of a small monthly premium. The directorate deals with the minister through the secretary of the department. The Director Health Services or his deputies and assistants can inspect all municipalities, district boards, factories and medical institutions etc. Due to the Act of 1919 the district boards and municipalities were entrusted with very high powers and could carry out any work, with the approval of Government regarding financial matters. The Health Department functions under the following heads :—

1. State Health Department.

2. Health and medical organisation for municipalities of urban areas.

3. Health and medical organisation for district board for rural areas.

The functions of the state department are, to control epidemic diseases and to organise preventive and curative works. It supervises these works in an advisory manner. But when such advice is ignored by a local body without any reason the government does take suitable action against it.

The Bhore Committee Report :—An all India Health Survey Committee consisting of 25 members under the chairmanship of Sir Joseph Bhore published an exhaustive report known as the Bhore Committee Report on 25th December, 1945.

The committee recommended a total expenditure of about 1000 crores of rupees during the first ten years in connection with the establishment and maintenance of a health service in India. It suggested a long term programme extending from 30 to 40 years and a short term programme to be implemented within 10 years.

Long term programme :—For this purpose a district health organisation is to be set up, with an arbitrary population of 3 millions in a district and so it is also called "3 million plan."

The details are :—1. The Primary Unit :—It will be serving a population of 10-12 thousands and will have six medical officers, six public health nurses and a 75 bedded hospital, with the required nursing staff. It will provide both preventive and curative health service. The public health nurses will visit homes and deal with the health of school children and the welfare of mothers and children.

2. The Secondary Unit :—A number of primary units (about 15-25) will constitute it and so larger staff will be employed. There will be an administrative officer who will be responsible for supervision and coordination of the work in the whole area.

There will be whole time heads of different departments of medicine, surgery, maternity, tuberculosis and pathology and two senior public health nurses and two senior sanitary inspectors.

3. The District Health Unit :—A number of secondary units about 3 to 5) together will form the District Health Unit. Its organisation will be thus on a large-scale with a provision for 2,500 beds.

Short term programme :—This is meant for supplementing the existing health services in the states. To start with, there will be 5 primary units in a district and each unit shall serve 40,000 population, with a 30 bedded hospital. A secondary unit will be established in each district at its headquarter and provide higher type of medical services.

Medical Census :—A medical census was taken in India in 1951 to ascertain the number of persons engaged in medical and health services. The results are as follows :—

Registered medical practitioners	91,930
Vaids and Hakims etc.	96,947
Compounders	38,407
Nurses	31.517
Midwives	23,938
Vaccinators	5,928
Dentists	3,283
Miscellaneous	72,970

Medical and Health Education : –Medical colleges were first opened in Madras and Calcutta in 1835 and recognised by the Royal College of Surgeons in 1845. Since then there has been a special provision for military medical students for the Indian Medical Department. At present there are 42 medical colleges in India. On the recommendation of the Inter-university Board an "All India Council of Post-graduates Medical Education", was set up. Recently an all India Institute of Medical Sciences has been set up at Delhi which would be one of its kind in South Asia.

For the post-graduate training in Public Health subjects, an All India Institute of Hygiene and Public Health is in existence at Calcutta. Diploma in Public Health is also imparted by Bombay University.

In the majority of states, health schools exist for the training of lady health visitors and arrangements have been made for training of sanitary inspectors, nurses, compounders etc.

Problem of Public Health in India :—The Planning Commission has stated that, "The incidence of sickness, the existence of disability, the death rate, the expectation of life at various ages and the relation of the active population to the total determine

the qualitative and quantitative use that can be made of the available man power." It has been estimated that nearly 75,000,000 persons suffer from malaria in any normal year and it takes a heavy toll of at least 750,000 lives. It has been estimated that about 2½ million active cases of tuberculosis exist annually and that ½ million deaths take place each year from this cause alone. The common infectious diseases *viz*, cholera, small-pox and plague are also responsible for a large amount of mortality. Moreover, malnutrition and under-nutrition reduce the vitality and power of resistance of an appreciable section of the population. Widespread adulteration of foodstuffs is doing, insidious harm to the health of people. Water supply is totally inadequate.

Control of Major Diseases :—In 1937, a movement was started against tuberculosis which was assuming an alarming proportion every year. It is estimated that nearly 15 Lakhs of people suffer from this disease and 5 Lakhs die of it annually. The large scale measures are taken by the Government in introducing the B.C.G. vaccination in controlling tuberculosis. It is being carried out on a mass scale since April 1951. Three training and demonstration centres for the control and prevention of the tuberculosis have been opened at Delhi, Patna and Trivandrum which impart training to the medical students, postgraduates etc. T.B. seals' sale campaign is being regularly organised by the Tuberculosis Association of India since 1950-1951.

A National Malaria Control Scheme was launched in 1953 as a part of the Five Year Plan. It provides for the establishment of 136 Field Malaria Control Units to give protection to 136 million people out of 200 million people residing in the malarious areas.

It has been estimated that there are over one million leprosy cases in India. "The mission to lepers" is the greatest voluntry organisation for anti-leprosy work. It was started in 1875 and has 95 institutions affiliated to it.

In India it is estimated that over two lakhs of people die of cancer annually. "The Tata Memorial Hospital of Bombay" and "Chitranjan Hospital of Calcutta" are the only two institutions for the treatment of cancer in India.

B C.G. Vaccine Laboratory at the K.E.M. Hospital, Guindy (Madras), the Central Drugs Laboratory Calcutta, the Central Research Institute Kasauli and Serological Laboratory Calcutta provide facilities for research.

Defectives :—Efforts are being made for the improvement of the lot of defectives in India such as crippled, blind, deaf, dumb and mentally defectives. It has been estimated that today the

number of blind persons in India totals about 1,800,000 and deaf persons number 600,000. There is a "training centre" for the blind at Dehra Dun to impart vocational training. There are in all about 50 institutions for the blind in India. The institutions for the deaf number 43.

Family Planning :—Limitation of population is recognised as an urgent, continuing and universal necessity. Growth of people in numbers seems to out strip food production. The problem is as old as the earliest Egyptian Papyrus and as new as the several recent volumes on world-wide spreading up of population increase. The better method of limitation of births is birth control. This has another advantage that it maintains the health of mother and children by proper spacing of children. The public should be educated and convinced to adopt a policy of limited procreation. Indeed in the matter of conception control, the main urgency is for effective simplicity and the search for this kind of a remedy should appear in all world programmes of science and culture.

Aims and methods of conception control :—(1) Pregnancy to occur as often as it is feasible to bear and rear a child with health, happiness and usefulness to progeny, parents and community. Fertile couples should be given council regarding additional pregnancies.

(2) Premarital examination to ascertain or develop mental and physical fitness for marriage and child bearing.

(3) Sexual intercourse to be adjusted in frequency, duration and response to mutual satisfaction and well-being of the partners.

(4) Conception to be controlled with these requisites in view, by one or more of the following methods primarily one in the wife's care.

A. For each occasion :—(1) Before coitus, the woman places a protective barrier in the vagina, such as cervix cover, pessary or watchspring diaphragm, tampon, jelly or suppository.

(2) The man wears a cover or sheath on the penis or lacking the above.

(3) The man with-draws after the woman's orgasm and before his ejaculation *i.e.* coitus interruptus or rarely coitus reservatus.

(4) Self diagnosis of "Safe period" or "Rythm period" and restriction there-to.

(5) The douche is relatively undependable.

B. For prolonged protection, she means as sperm immunity or ovulation control, irradiation, hormones or heat to the testicles, only if the research can prove that their use is safe and effective.

C. For permanent protection, when necessary sterilisation without unsexing by surgical closure of spermatic ducts of males or oviducts of females, in office or in hospital or for the inoperable near the menopause by irradiation.

D. To foster desirable fertility and plan each pregnancy ; infertile couples to be systematically studied and treated.

E. To discover methods utterly simple and cheap for the poor and ignorant and the peasantry of over-populated countries. Extensive basic research.

The planning commission gave importance to the family planning in India in order to maintain proper balance between increasing population and limited resources of the country. A provision of rupees 65 lacs was made in the first five year plan for :—1. Educating the people about family planning. 2. Training health personnel and 3. Finding cheap, dependable and harmless methods of birth control. Three pilot schemes *viz.*, two in Delhi and one in Mysore were started to assess the value of "rythmic" or "safe period" method. In the second five year plan, a provision of rupees four crores was made for this purpose and it was proposed to start 300 urban and 200 rural clinics.

Family Planning Association of India :—It was founded in Bombay in July 1949. Its aims and objects are :—

(1) To impress upon the public the necessity for family planning and to give guidance on reliable methods of achieving it.

(2) To work for the establishment of centres where married couples can get advise on :—(a) spacing of the birth of children. (b) the use of scientific contra-ceptive methods. (c) treatment of childless couples desiring to establish a family. (d) marriage problems.

(3) To endeavour wherever feasible, to supply the necessary contraceptive appliances to married couples of low and middle income groups at as low a cost as possible.

(4) To collect information and statistics relating to family planning.

(5) To foster and develop contacts with organisations engaged in a similar type of work in the India and abroad.

Activities :—

(1) It is developing the "*Kutumb Sudhar Kendra*" to become alround health and welfare centre where parents can receive help and guidance. (a) to space or limit their families (and also to be treated for infertility in order to start a family if possible) where that is what a couple desires. (b) to receive medical and psychological guidance for sex or other marital difficulties. (c) to learn how best to care for their children and themselves in order to insure health and fitness. For this purpose, a Well-Baby and Well-Mother clinic is shortly to be started at the *Kendra*.

(2) It is arranging short training courses for qualified medical personnel on the various aspects and tecnniques of family planning.

(3) It is helping to establish family planning clinics in various parts of India.

(4) It is intensifying its educative drive by talks, film shows, posters, pamphlets, etc., giving information on family planning to an ever wider public.

Hospital Social Service : —It is defined in England as follows :

1. Service to the patients as a part of hospital treatment.
2. Service as a connecting link between the hospital and the public in the treatment of the individual patient and the general health programme of the area covered.
3. It serves to create better understanding through interpretation of the hospital to the public and public to the hospital, strengthening the work of both, by bringing about better results.
4. It serves to assist in research by studying groups of cases and helping to remove causes of disease, and increasing facilities for complete treatment and when the need is indicated by such study.
5. It makes a definite contribution to the education of medical students, nursing pupils and general social workers.

Medical Social Worker :—She is trained in social welfare work and its application to medicine. She is a person to advise patient's doctors and others about sociological and psychological aspects of patient's problems. She supplements medical history which includes facts of heredity, personality, manners of life, home environments, financial worries, dependants, character of employment, strain and hazards incidental thereto, reaction and standards of living generally, etc.

In Western countries, the course prescribed is that she must have had four years training in a college and obtained a bachelor's degree plus experience of two additional years in an accredited programme of study in the medical aspect of social work. It includes a year's field work under supervision.

Smillie says, "The medical social worker was introduced first into the outpatient clinic services, and then added to the hospital staff as a part of the medical team. It is not her sphere to diagnose disease nor to administer therapy. She is trained to understand and to help the patient, solve personal and family problems. She is also trained to observe and interpret the relationship of social and economic conditions to disease, and to recognize the particular social problens that are produced by illness."

For the health worker Social Medicine means :—1. A study of social effects of disease, especially the effects of disease on the family unit.

2. Individual health education and advising people about the medical aspects of their problems, etc.

3. The provision of a variety of Social Services to relieve domestic stress and to support curative medical services.

4. A research method used to identify social circumstances which favour a high incidence of disease.

"The medical social worker has now established herself as an invaluable person in the overall comprehensive plans for care of the sick. She aids also in the prevention of recurrence of illness, and is of great assistance in promotion of individual's and family's health and stability. Her main concern is the social situation of the patient. She studies his family relationships, his whole economic status, and his home and work environment, and makes an estimate of the manner in which these factors may relate to his illness. With those facts at hand, she may aid in making plans for carrying out of his treatment and for his subsequent rehabilitation of all of those factors that impinge on his life, and that may be affected by his illness, are reviewed, as well as the influences of his home environment that may have an effect upon his recovery, are reviewed.

Medical social workers conduct their activities in the hospital, in the clinic, and in the home. They help the physician to understand the particular situations and problems of the patient, and also help the patient to meet and solve those situations which to him at off times, may seem hopelessly insurmountable.

The social worker accomplishes her results on the basis of individual case studies. Each person and each situation must be

handled in accordance with his particular needs. The most important tools that the medical social workers use are :—

1. Material relief, in which actual funds may be provided to tide the patient over an emergency, or until the patient may be aided in securing material assistance through his own resources.

2. The medical social worker is familiar with all the resources of the community, and assists the patient in choosing the particular agency or facility that will be of greatest use to him She also explains just what benefit he can expect to receive from each source of assistance.

3. The social worker aids the patient in understanding his illness and in adjusting his life to the actual situation. Often times it is necessary to discuss matter with the family, in order to help them to understand the situation, and perhaps to change the family attitude toward the patient and his illness or handi cap. Often the social worker contributes to the medical care of the patient by helping him to understand the urgent necessity for following his treatment exactly as recommended by his physician"

Public Health Nurse :—The activities of health department of the last century had no place for a nursing service, no interest in individual health promotion. As public health nursing has evolved, our concept of the functions of a public health nurse have changed markedly. They are still changing.

The major function of the public health nurse is educational. Everything she does, including the bedside care that may be given, is an education measure, as well as direct service to the family. It is her duty to aid each of the families in her jurisdiction to prevent disease and to promote health in all members of the families.

She secures early medical diagnosis and treatment for those who are sick, she renders or secures nursing care for teaching the patient and the family by demonstration and by supervision The nurse aids the family in making adjustments of social conditions affecting the health of its members; she helps to create positive attitude in the home towards the acquisition and maintenance of health. Another important function is case finding, especially the early cases and getting them under early treatment. The activities in which she participates are :—

(1) Maternity and child welfare service.
(2) Preschool and school health.
(3) Communicable diseases control.
(4) Nutrition,
(5) Mental hygiene activities, orthopedic service.

Public Health nursing service is still in infancy in India. In Western countries it is usually organised as a service division of the health department, with a Director of nursing and one Supervisor of the nursing for each 8 to 10 of the nursing staff. Often there is no real distinction between a preventive and curative service.

General functions of the Public Health Nurse :—They are as follows :—

1. To help in securing early medical diagnosis and treatment of the sick.

2. To render or secure nursing care of the sick. To super vise the care given by the relatives and attendants.

3. To help the family in carrying out medical, sanitary and social procedures for the prevention of the disease and promotion of health.

4. To help in adjusting the social conditions affecting health.

5. To influence the community to develop public health facilities through participation in appropriate channel of community education for the promotion of a sound adequate community health programme and to share in community action leading to betterment of health conditions.

Specific functions :—They may be grouped as under :—

(*a*) *For communicable diseases* (especially Tuberculosis, Syphilis, Gonorrhoea. etc.) :—1. She will improve the reporting of the notifiable diseases and visit homes for giving necessary instructions regarding importance and method of isolation, concurrent disinfection, care of the attendants, etc. in order to stop further infection.

2. She will arrange for the examination of contacts, etc.

3. She will teach the importance of personal hygiene and precautions to prevent spread of infection.

4. She will help the patient and the family with mental and social adjustment.

5. She will help in enlightening services of clinics, sanatoria, private physician, health department and other related health and social agencies.

(*b*) *For maternity and child welfare* :—

1. She will help the physicians in antenatal clinics and at the time of delivery.

2. She will instruct the mothers and the prospective parents in maternity and child health including the nutrition and proper habit formation.

(c) *For industrial Hygiene* :—

1. She will assist the physician in medical examination and health supervision.

2. She will render first aid.

3. She will teach personal hygiene.

4. She will help in procuring professional attention for defectives.

5. She will co-ordinate the industrial nursing services with medical services in the community.

India and the International Assistance :—India has been a member of the World Health Organisation since 1948. India has been receiving striking assistance from the World Health Organization and United Nations International Children's Emergency Fund. Help from these organizations generally assumes the form of improving existing services, medical literature, fellowships and equipment. They have done much to control and cure tuberculosis, venereal diseases, malaria, and improve child health in this country.

World Health Organization :—The World Health Organization came into official existence in 1948, with the signing of its constitution by the representatives of 61 nations. It is the agency of United Nations with its headquarters at Geneva in Switzerland *i.e., Palaisdes Nations*, for the purpose of co-ordinating and directing international health work. Its objective is to work for the attainment by all people for the highest level of health.

Preamble of the constitution of W.H.O. :—The health of all people is fundamental to the attainment of peace and security and is dependent upon the fullest co-operation of individuals and protection of health is of value to all. Unequal development in different countries, in the promotion of the health and control of diseases especially communicable diseases, is a common danger. Health development of the child is of basic importance, the ability to live harmoniously in a changing total environment is essential to such development.

Problems to be given to priority are malaria, tuberculosis, venereal diseases, maternal and child health, nutritional and environmental sanitation. World Health Organisation is organised to furnish medical facilities to member nations to collect the world-wise statistics, to serve as a central clearing house for a rapid exchange of epidemiological information, to eradicate epidemic and endemic diseases, to encourage and conduct scientific research to disseminate medical information and to assist in the medical development of an informed public opinion on matters of health. It is also concerned with the standardisation

of drugs, biological, preparations, diagnosis procedures and nomenclature with respect of disease and causes of death.

For administrative purposes the world has been divided into 6 regions :—(1) South East Asian countries *i.e.*, India, Ceylon, Nepal, Burma, Thailand, Indonesia and Afghanistan with New Delhi as their head quarters.

(2) America,

(3) Europe,

(4) Eastern Mediterranian Muslim countries including Pakistan.

(5) Western Pacific countries.

(6) Africa.

Finances of World Health Organisation :—They are provided through the voluntary contribution by various member countries. They contribute according to their ability to pay but get aid according to their requirements. Thus in 1954, India contributed 12 lakhs of rupees and got aid worth Rs. 24 lakhs. Projects for which aid is given must be for the country as a whole and they must be accomplished by the State Government concerned even when the aid is withdrawn after three years. Aid is given in the form, of expert personnel and equipment.

World Health Day :—On the 7th April 1948, the constitution of the World Health Organization officially came into force. Each anniversary is now observed as World Health Day and is used by national local authorities to interest people in health needs and to stimulate their co-operation in health action.

United Nations International Childrens' Emergency Fund i.e., UNICEF :—It is also a specialised agency of United Nations Organisation like World Health Organisation. It was started in 1946, after the Second World War, to benefit the mother and children of various countries involved in that war. Since 1950 however the Fund is applicable to all under-developed countries. Hence, now the words international and emergency have been dropped from the name of the organization. It is now called United Nations Children Fund but abbreviatson in vogue is still UNICEF.

Like World Health Organisation it has 80 (eighty) member countries. It gives aid to all nations without discrimination of race, colour, political belief etc. Russian and other communist countries are also its members. For administrative purposes the whole world is divided into four regions, *viz.* (1) Asia with Bangkok as its headquarters (2) America (3) United Kingdom and Africa and (4) Europe, Eastern mediterranean countries and France.

Aid is given only for those projects which are to prevent disease and to promote health of the mothers and children. Up to 1954 about 80 million children of the world have derived benefit from this fund, in some form or the other.

Various projects aided by UNICEF in India are :—Some of the projects and schemes on public health which have been initiated in India recently, after having received aid in the form of personnel and material from the UNICEF are the well-known B.C.G. Campaign, venereal diseases control programme, yaws control programme in hilly tracts of Madhya Pradesh, Hyderabad, Andhra, installation of a penicillin factory near Poona, and a D.D.T. factory near Delhi, a dairy plant at Bombay, opening of maternity and child health and nursing training centres at Calcutta, a Pediatric centre at Madras, provision for dried skimmed milk to needy children, nursing bags, etc. for lady health visitors, midwives and other equipment required for maternal and child health centres, etc.

First Five Year Plan :—After independence in 1947, our national Government realised that nation's health is perhaps the most potent single factor in determining the character and extent of its development and progress and any effort on improving the national health and expenditure of money in respect thereof, was an investment which yielded immediate and steady return in increased productive capacity. Hence in 1950, the First National Five Year Plan was drafted and its main aim was to fight against disease, unhealthy environments and malnutrition.

The Five Year Plan earmarked Rs. 99.55 crores for medical and public health schemes. The Central Government proposed to spend Rs. 17.87 crores from this amount mostly on the proposed All India Medical Institure and National Malaria Control Programme.

The following statement shows the distribution of this amount in lakhs of rupees :—

	Medical	Public health	Total
Central Government	565.23	1,222.20	1,787.43
Part A States	3,394.30	2,956.00	6,380.30
Part B States	580.70	657.40	1,238.10
Jammu and Kashmir	46.00	82.20	128.20
Part C States	222.50	228.00	450.50
	4,808.73	5,145.80	9,984.53

In the first Five Year Plan a sum of Rs. 2,069 crores was spent which was distributed as under :—

Agricultural community development	17.5%
Irrigation and power	27%
Transport and Communication	24%
Social services (including medical and health services)	16.6%
Industry	8.4%
Rehabiliiation of refugees	4%
Miscellaneous	2.5%

Among the social services are included medical and health services, education, housing, backward classes, etc. Out of Rs. 340 crores a sum of Rs. 100 crores (99.55 crores) was earmarked for medical and health schemes.

The order of preference given to various health programmes was as follows :—

1. Provision of safe water supply and disposal of excreta.
2. Control of mass diseases such as malaria, tuberculosis, venereal diseases, cancer and mental diseases.
3. Preventive health care of the rural population through health units and mobile units.
4. Health services for mothers and children.
5. Health education and training.
6. Self-sufficiency in drugs and equipment.
7. Family planning and population.

This plan was completed by the 30th March, 1956. The country made progress in every respect. The chief achievements were :—Health and medical provisions become comparatively better. The country was on its way to become self-sufficient in food and various other productive commodities. Moreover, mighty irrigational and industrial works, dams, etc. were on their way to completion. There was every reason to believe that the country would fare far better in the Second Five Year Plan as compared to the First Five Year Plan.

Second Five Year Plan:—The aims and objects of this plan were to increase per capita income and national income as a whole by 25%, rapid industrialisation, specially heavy industries and the increased agricultural productivity and employment.

Supervision :—There is a National Development Council for general supervision consisting of members of the Planning Commission, the Ministry of the Union Government and the Chief Ministers of the states. The council has a standing committee of 14 members consisting of the members of the planning commission, the Chief Minister of Bombay, Madras, Uttar

Pradesh, West Bengal, Punjab, Travancore-Cochine, Mysore, Hyderabad and Rajasthan.

Finances : –A huge sum of Rs. 7,100 crores (*viz.* Rs. 4,800 crores for public sector and Rs. 2,300 crores for the private sector) were provided, to implement the various schemes and programmes as per details given below :—

1.	Heavy industries and transport	48%
2.	Irrigation and power	18%
3.	Agriculture and community projects	12%
4.	Social services	20%

Government of India had to incur an expenditure of Rs. 950 crores on the above sectors, out of which a sum of Rs. 220 crores was proposed to be utilized for the extension and betterment of medical and public health services only. This amount was to be spent on its various branches in the following order of priorities : –(1) Health centres. (2) Training of medical and health personnel. (3) Control of mass diseases. (4) Improvement of environmental sanitation and family planning.

Details, of comparative study of the First and Second Five Year Plans and the state of affairs prevailing before the implementation of these schemes are well reflected in the following tabular data :—

Items	**Before 1951**	**First Five Year Plan 1951–56**	**Second Five Year Plan 1956–61**
Total outlay	Rs.	2069 crores	Rs. 7100 crores
Outlay for medical and health services	——	100 ,,	,, 270 ,,
Hospitals	8,600	10,000 ,,	,, 12,600 ,,
Hospital beds	1,13,000	1,25,000 ,,	,, 1,55,600 ,,
Health Units	———	725 ,,	,, 3,000 ,,
Medical Colleges	30	40 ,,	46 ,,
Dental Colleges	——	6 ,,	10 ,,
Doctors	59,000	70,000 ,,	80,000 ,,
Nurses	17,000	22,000 ,,	31,000 ,,
Midwives	18,000	26,000 ,,	32,000 ,,
Health visitors	600	800 ,,	2,500 ,,
Nurse dais	4,000	6,000 ,,	41,500 ,,
Sanitary Inspectors	3,500	4,000 ,,	7,600 ,,
Malaria	———	(Rs. 17 crores) 162 units 162 million population	(Rs. 27 crores) 200 units 200 million population
Filaria		Control Units 13	Control Units 65

Tuberculosis	Survey Units 22 166 clinics. 15,000 beds, 21 million children were given BCG Vaccination and 63 million children were tuberculin tested	Survey Units 22 Entire population to be covered
Venereal Diseases	Rs. 1 crore	--
Leprosy	35 centres	135 centres
Maternity and Child Health	——	2100 centres and 4 Regional Pediatric centres.
Family Planning	Rs. 651 lacs (This amount was not meant for contraceptives).	Rs. 5 crores, 300 urban clinics, 2000 rural clinics. For use of contraceptives,
Environmental Sanitation	Rs. 22 crores rural, Rs. 26 crores urban for water supply.	Rs. 25 crores for urban sanitation by Central Government Rs. 10 crores to assist urban water supply improvement schemes, Rs. 27 and 23 crores to be provided by the state Govts. for improvement of rurul and urban water supply schemes respectively.

THIRD FIVE YEAR PLAN

A Provision of Rs. 342 crores has been made in the Third Plan for health and family planning programmes as against Rs. 140 crores and Rs. 225 crores in the First and Second Plans respectively.

The Plan lays increased emphasis on preventive public health services. As in the Second Plan, specific programmes have been drawn up for improvement of environmental sanitation, specially rural and urban water supply, control of communic-

able diseases, organization of institutional facilities for providing health services and for training of medical and health personnel. High priority has also been accorded to family planning for which Rs. 50 crores have been earmarked.

The report records substantial progress in various health programmes. There has been a marked decline in the incidence in malaria. Considerable progress has also been made in controlling other communicable diseases like filaria, tuberculosis and venereal diseases. The number of hospitals and dispensaries has increased from 8,600 in 1950-51 to 12,600 in 1960-61 and of beds from 113,000 to 185,600. About 664 schemes of urban water supply and drainage entailing at a total cost of Rs. 112 crores have either been completed or in progress.

According to the report, there has been a steady improvement in the health of the population. This is indicated by the following table.

Birth rates, death rates and expectation of life—1941-61.

Period	birth rate	death rate	rate		life at birth	
			male	female	male	female
1941-51	39.9	27.4	190.0	175.0	32.45	31.66
1951-56	41.7	25.9	161.4	146.7	37.76	37.49
1956-61	40.7	21.6	142.3	127.9	41.68	42.06

The broad aim in the Third Plan will be to remove the shortages and deficiencies that have hampered the implementation of various health programmes during the Second Plan. A major objective is to make available supply of good drinking water in most villages in the country by the end of the Third Plan. Institutional facilities are to be expanded so that medical and health services reach progressively a larger number of people, specially, in rural areas. While programme for the eradication of malaria will be completed, effort will be made to eradicate other communicable diseases. Drainage programme will also be undertaken on a large scale in the urban areas.

The number of hospitals and Dispensaries is to be increased to 14,600 from 12,600 by the end of the Plan period, doctors from 70,000 to 81,000, nurses from 27,000 to 45,000, primary health units from 2,800 to 5,000, medical colleges from 57 to 75, annual admissions in these colleges from 5,800 to 8,000 and maternity and child welfare centres from 4,500, to 10,000.

Surveys are being undertaken to ascertain the present state of rural water supply. A provision of Rs. 67 crores has been made. This includes Rs. 35 crores for the village and water supply programme, about Rs. 16 crores under the Plans of the States under health, Rs. 12 to Rs. 13 crores under the community

development programme and about Rs. 3 to 4 crores under the programme for the welfare of backward classes.

A sum of Rs. 89 crores has been provided for urban water supply and drainage schemes. The urgency and importance of providing drainage and sewerage and arranging for safe disposal of sewage in towns and cities also need greater attention. These facilities are at present lagging behind the water supply facilities and it is, therefore, necessary that the schemes of drainage are considered simultaneously with those for water supply and are carried out under a co-ordinated programme.

A total expenditure of Rs. 23 crores was incurred on the control of communicable diseases in the First and Rs. 64 crores in the Second Plan. The Third Plan entails a total outlay of Rs. 70 crores for this purpose. Work on the control of these diseases will be undertaken on a much larger scale. The BCG vaccination campaign will be intensified to cover another 100 million persons. The number of TB clinics will be increased from 220 to 420. About 3,500 more beds for tuberculosis patients will be added bringing the total number to 30,000 by 1966.

The Plan provides Rs. 3.5 crores for the expansion of facilities for post-graduate education. This programme has a very high priority and is to be completed in the early years of the Plan.

To improve the condition of service for nurses and to attract larger numbers of women to this profession it is proposed that in each State there should be a special nursing service and a nurse superintendent should advise and assist the Director of Health Services.

Special emphasis has been laid on imparting health education. It is estimated that the number of children in schools will increase by 20 million at the end of the third Plan. As the incidence of sickness and disease among these children due to maltreatment and other preventive causes is extremely high, cartain measures have been suggested to prevent it. These include clear drinking water and sanitary facilities in schools, arrangements for medical inspection, and instruction of teachers in health education. In view of the importance of school midday meals, specially for the poor children, this programme, it is suggested, should be extended progressively.

The Plan also envisages a large increase in the production of the drugs in the country and replacement of imported drugs and raw materials by indigenous manufacturers. It calls for special efforts to prevent the production of spurious drugs and food adulteration. It suggests that co-opertive consumer stores should be built up, specially, in towns, as a means of

assuring the supply of pure food stuffs. There is also increased emphasis on encouraging the indigenous system of medicine.

The programme for family planning provides for (a) education and motivation for family planning, (b) provision of services. (c) training, (d) supplies, (e) communication and motivation research, (f) demographic research and (g) medical and biological research. It involves a total outlay of Rs. 50 crores.

Family planning services have to be made available much more widely than at present. According to tentative programmes drawn up for the Third Plan, that number of family planning clinics is likely to increase from about 1,800 to 8,200. About 6,100 clinics may be in rural areas and 2,100 in the urban areas. Distribution of simple contraceptives and general advice should be entrusted in a much larger measure to the voluntary organizations, to paramedical personnel and to 'dais' specially trained in family planning work.

It is further stated that a large scale of family programme has to be supported necessarily indigenous manufacture of contraceptives. Detailed plans for the production of these both by the Government and private firms should be drawn up as a matter of high priority.

Over the past five years, facilities for sterilization operation have been extended in several States and about 125,000 operations have been carried out. It is visualizd that during the third Plan facilities for sterilization will be extended in district hospitals, subdivisional hospitals and to such primary health centres as have the necessary facilities for surgical work. With the help of mobile units, these facilities can be extended.

The report says that besides the facilities which are undoubtedly needed, in any large scale effort to limit families, there should be the greatest emphasis on moral and psychological elements, on restraint and on such social policies as education of women, opening up of new employment opportunites for them and raising the age of marriage. In addition to advice on birth control, the family planning programme should include sex and family education.

National Malaria Control Programme :—Malaria has been recognised as by far the biggest and most important health problem in India. It was estimated that about 100 million people suffer from this disease every year of whom about a million die. Apart from this high incidence of disease, malaria is also responsible for untold sickness and sufferings. The economic loss to the nation due to malaria is incalculable and must run into hundreds of crores of rupees every year.

According to the information collected from Directorates of Health Services of various States in 1952, the total population requiring protection from Malaria in this country was estimated to be 200 million.

The Health Survey and Development Committe recommended in 1946, the creation of an organisation at the headquarter of each State and establishment of a number of malaria control units, each under Medical Officer, especially trained in antimalaria work for operating in the affected areas in different parts of the State.

During the First Five Year Plan, Planning Commission reviewed the question of malaria control on a country-wide basis and recommended that this disease being a *Public Health Enemy No. 1.* should be given top priority and should be carried out through a central organisation in co-operation with States.

To implement this recommendation, a comprehensive programme of malaria control in India was drafted in consultation with representatives of International Organisation interested there-in and some of States' Anti-malaria Organisations and this brought into its wake National Malaria Control Programme. This programme was examined as a "project" by the Planning Commission with reference to point four Indo-American Aid programme.

Saturday December 31, 1952, was thus a landmark in the history of malaria control in India, when the National Malaria Control Programme was launched with an agreement signed in New Delhi between India and U.S.A. Within a short space of time, the National Control effects progressed by leaps and bounds. Inspite of an aparant complexity of problem, from small beginning in towns, the work had spread in ever-widening circles. With the co-operation of the people, control measures were directed towards the freedom for the people from the potential dangers of devasting effects.

The Technical Co-operation Mission of U.S.A. provided equipment. D.D.T., anti-malaria drugs, transport, etc. for supply to State Governments participating in the programme. A provision of Rs.15 crores of which Rs.10 crores were to be contributed by the Central Government and T.C.M. and Rs. 5 crores by the state was made for this vital scheme. The Malaria Institute of India coordinated the whole programme and distributed supplies. It was also responsible for research and training staff in methods of malaria control.

During the First Five Year Plan, 162 malaria control units were set up to do anti-malaria work. The programme consists of residual D.D.T. spraying of insecticides in houses and treatment

of patients with anti-malaria drugs in malarious areas. One unit is expected to protect one million population.

National Malaria Eradication Programme :—According to the various resolutions passed by the World Health Assemblies emphasizing the need for total eradication of malaria, the Government of India embarked on a nation-wide eradication campaign in April 1958. This was a landmark in the history of public health administration in India and is the most gigantic health project ever launched by any country in the world. In this huge project the United States International Cooperation Administration and the World Health Organization are also collaborating.

'Malaria Eradication., according to the Sixth Report of the Expert Committee on Malaria which met at Athens in June 1956 under the auspices of the WHO, means the ending of transmission of malaria and the elimination of the reservoir of infective cases in a campaign limited in time and carried to such a degree of perfection that, when it comes to an end, there is no resumption of transmission that differs from malaria control in many ways. Whereas malaria control aims to bring the disease down to a prevalence that it is no more a major public health problem ; malaria eradication aims at the total eradication of malaria parasite. It has been shown that it is possible to achieve malaria eradication.

PLANNING AND ORGANIZATION

In order to achieve the desired standards of efficiency, the activities of Malaria Eradication should be looked upon as an urgent measure outside the regular routine of health departments. Proper planning and perfect organization is the *sine qua non* of any malaria eradication scheme.

Malaria eradication activities should have the support of legislation. There should be a continued assurance of availability of funds and budget. The budgetary requirements of the campaign are well within the financial means of the countries concerned. Proper training of personnel and high standards of efficiency and caliber on the part of all employees is a must in any programme. Malaria Eradication programmes have four phases :

1. *Preparatory* :—This includes an initial survey, planning and preliminary organization. The primary purpose of this survey is to delimit the malarious area of the country, if this has not been already done. Training of staff should also be carried out during this phase. Normally this lasts a year.

2. *Attack* :—As soon as the preparatory phase has ended the attack phase starts. This means a complete coverage of

the whole area until the cessation of malaria transmission and emptying the parasite reservoir. The assessment and evaluation of attack phase are measured in terms of what remains to be done rather than what has been accomplished. Normally this phase may last for three years.

3. *Consolidation* :—This begins when the attack phase has come to an end. During this phase, all residual pockets of transmission should be investigated and eradicated. This phase is also termed the surveillance. Active case finding and administration of anti-malarials form the chief method of eradicating the residual foci of malaria transmission. Normally this phase continues till three years of active surveillance.

4. *Maintenance* :—The phase of maintenance begins when the activities of consolidation or surveillance have come to an end. Before this phase begins all the criteria of eradication must have been met.

Within the Ministry of Health, and the Directorate of Health Services, a full time Director of the National Malaria Eradication Programme directs and coordinates the Programme. At the state level, the activities are conducted with the direction and supervision of State Malariologists within the State Ministries of Health and the Directorates of Health Services.

At present there are 390 units in the country, each of which covers a population of one million. Unit is the lowest functional group within the programme. Each unit consists of :

Malaria Officer :	1
Assistant unit officer (Non-medical in-charge of spraying logistics)	1
Senior Malaria Inspectors	4
Malaria Inspectors	4
Technicians	2
Accountant	1
Store keeper	1
Upper division clerk	1
Mechanic	1
Motor drivers	5
Motor cleaners	5
Peons	4
Chowkidar	1
Sweeper	1
Superior field workers for 12 months	4
Field workers for 12 months	10

	Endemic Units in Plains	Endemic Units in difficult areas
Superior Field Workers for 5 months	32	44
Field Workers for 5 months	170	230

	Hypoendemic Units
Superior field workers for 2½ to 3 months	32
Field workers for 2½ to 3 months	170
Surveillance team per unit :—	
Inspectors	25
Surveillance workers	100

In addition to above, six inter state (regional) organizations, each covering two or three States, have been organized to give technical direction.

The amount of DDT per round of spray per unit has been increased from 35.5 tons of 75% wettable powder to 45 tons depending on the area and requirements.

Besides the normal quota of four trucks and one jeep, 300 trucks were to be procured as a reinforcement to be allotted to those units operating under the control programme. Each unit was to be provided with two microscopes, as well as 60,000 slides and anti-malarials.

Each unit is supplied with 30 Hand compression sprayers and 60 Stirrup pumps.

The National Expenditure authorized for anti-malaria work in India in 1959 was in the region of 20 million US dollars. The malaria expenditure budget as compared to the total health budget in 1958 was 19. 5%. Estimated cost for the Third Five Year Plan period is Rs.58.37 crores.

38 units in addition to 162 already set up under the First Plan would be needed during the Second Five Year Plan to extend protection to 200 million people who are exposed to risk.

One malaria control unit consists of the following staff :—

Medical Officer	...	1
Senior Malaria Inspectors	...	4
Malaria Inspectors	...	4
Store-keeper	..	1
Accountant	..	1
Clerk	..	1
Van Cleaners	..	5
Van Drivers	..	5
Mechanic	..	1
Peons	..	4

Watchman	..	1
Superior Field Workers (regular)	..	4
Field Workers (regular)	..	10
Superior Field Workers (5 months)	..	20
Field Workers (5 months)	..	110

The following transport and equipment is provided to each unit :—

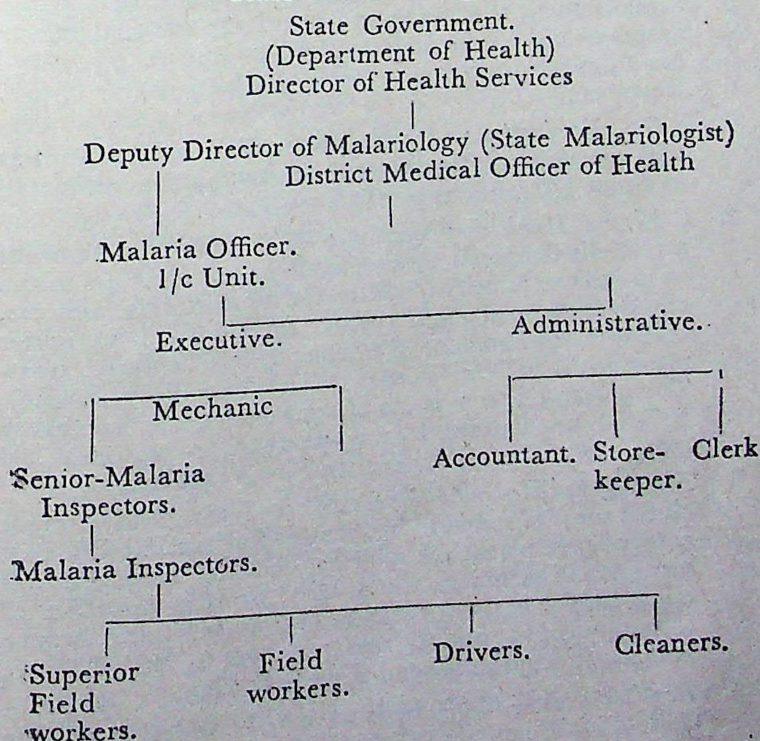
Trucks	..	4
Jeep car	..	1
Hand compression sprayers	..	30
Stirrup Pumps	..	60

Each unit is supplied with 53.3 tons of 75% wettable powder and anti-malaria drugs annually.

Besides above, each state has been supplied with two microscopes. Some of States have been supplied with station wagons.

The cost per unit to a State Government is estimated to be Rs. 1,32,000/-. Nine such anti-malaria units are functioning in Punjab state. The State Malaria Organisation varies from state to state but general pattern is shown diagramatically in a chart below :—

State Malaria Organisation



Tuberculosis schemes included under the Second Five Year Plan :—

Introduction:—It was estimated that in India there were about 25 lakhs of patients suffering from active tuberculosis and about 5 lakhs die every year due to tuberculosis. According to Western standards, to deal with such a situation, we would require 500,000 hospitals beds and about 4,000 Tuberculosis clinics.

Existing facilities :—There are at present in India 139 in-patient institutions including sanatoria and hospitals. The total number of beds at present available for tuberculosis patients in the country is about 29,138. The number of clinics is 170. There are about 130 B.C.G. vaccination teams with over 150 doctors and 750 technicians. The number of people who have been tuberculin tested is 75 millions, 18 millions have been given B.C.G. Vaccination.

Second Five Year Plan:—The following items were included in the Second Five Year Plan :—

1. B.C.G. Vaccination.
2. Establishment of clinics and domiciliary service.
3. Establishment of training and demonstration centres.
4. Provision of beds for isolation and treatment.
5. Facilities for after-care.
6. Research.

1. *B.C.G. Vaccination* :—It was planned to tuberculin test and vaccinate all the susceptible population estimated at about 170 millions by 1961.

2. *Clinic and Domiciliary Service* :—The main functions of a clinic is diagnosis, advice and follow up. In India owing to the paucity of beds for tuberculosis patients, clinics have been given a wider function *e.g.* to undertake a certain amount of treatment, particularly treatment in the patients' homes. (*i.e.* domiciliary service). The ultimate aim was to have one clinic for every 100,000 population. It was planned to establish 300 more clinics during the Second Five Year Plan.

3. *Training and Demonstration Centres* :—Some of the larger clinics were planned to be centres for training different categories of personnel such as doctors, nurses, health visitors and technicians and also for demonstration of clinic service of proper standard. Four such centres were already working and it was planned to add 10 more centres during the Second Five Year Plan.

4. *Hospital Beds*:—10,000 beds were to be added during the 2nd. Five Year Plan. These beds were to be provided

in crowded localities especially for isolation of infectious patients living in unhygienic homes.

5. *After-care and Rehabilitation* :—The need for after-care colonies and rehabilitation centres for ex-tuberculosis patients was fully recognised. At that time only 5 such centres were existent. The 2nd Five Year Plan provided for the establishment of 8 more work centres, mainly in association with the larger clinics, where patients, ex-patients and their families would be taught handicrafts, some of which can be carried out by them as cottage industries.
6. *Research* :—A Chemotherapy Research Centre was started in Madras. The research was being carried out by I.C.M.R. on behalf of Government of India with the active cooperation of W.H.O. and Britain Medical Research Council. The main object of this investigation is to find out the efficacy in tuberculosis, with the new antibacterial drugs.

National Smallpox Eradication programme :—The Central Ministry of Health has proposed to embark on a nation-wide basis the National Smallpox Eradication programme during the 3rd 5 Year Plan. The proposal has been accepted by the Planning Commission. One of the preparatory steps in this direction has been the starting of pilot projects in the states during the year 1960-61.

The Central Fxpert Commisson on Smallpox has recommended that the entire Smallpox Eradication programme should be completed within a period of 3 years from the date of its inception; the programme being carried out in two phases, the first phase being devoted primarily to planning and obtaining necessary equipment etc., and second phase to the actual work of vaccination. The 1st phase of the programme envisages interalia the provision of additional facilities at the existing vaccine producing Institutes of the country for the augmentation of vaccine lymph supplies.

In view of the National importance of Smallpox Eradication project and with a view to attaining the targets in respect of production of vaccine lymph, the Govt. of India has decided to give cent percent central assistance to the states. The scheme is essentially centrally sponsored and the expenditure is to be received by the state Governments in the form of subsidy.

There are at present 13 vaccine Institutes in 11 States of the country providing all the smallpox vaccine used in India. The present capacity of vaccine production of all these Institutes is about 75 million doses annually.

Approximately 250 million additional doses of vaccine lymph will be needed for the National Smallpox Eradication programme which envisages vaccination of entire population of the country estimated at 430 million in 1961. Government of India has procured 250 million doses of freeze dried vaccine; from Russia instead of manufacturing it in the country. The whole scheme has been worked out, and is under the active consideration of the Government of India. The Scheme has been thus finalised and commenced from 1961-62 onwards and the entire programme will be concluded with in a spell of 3 years.

COMMUNITY DEVELOPMENT PROJECTS

Background and origin :—India has adopted the idea of a welfare State. It is trying to carry out its principles in practice. The idea of a wellfare state must be very old but its conception of 'welfare' as the primary object of the state is new.

There is colossal poverty in our country. Our per capita income is only Rs. 273 per year. Besides, there is the terrific population pressure. About 10,000 more mouths to be fed are being added every day in India. Our country is rural, as 82 per cent of the population lives in the villages. There are 5½ lac of villages with a population of 294 million and the principal aim of the welfare state is to deal with poverty. The National Government, therefore, rightly thought of the development of villages.

When the First Five Year Plan (from April, 1951 to March, 1956) was started, it included the Community Development Project for revitalisation of villages. The term "Community Project" is American, but the plan is not American. The development programme is 100 percent Indian. It is a real rural development programme. The main purpose is to eliminate triple enemy of the villager, *i.e*, poverty, ignorance and disease. It is the project of the people, for the people.

The sheet-anchor of the whole programme is self-help. The success of the programme will be affected by how much the villagers have been 'excited'. The creation of leadership among the village people for solving their own problems is the aim of the project.

Details of a Project :—An area for intensive work in all fields is selected. Each project covers about 300 villages with an area of about 600 square miles and a population of about 2 lacs. Each project consists of three blocks. Each block has 100 villages and a population of about 70,000. Each block is

again divided into several sub-blocks. Each sub-block has 5 to 10 villages, under the charge of a Gram-Sewak or Village-level Worker. This is the lowest unit of the block.

Each project was to cost 65 lacs of rupees, over a period of 3½ years in the First Five Year Plan.

This is a comprehensive and multi-purposes scheme. The expenditure is incurred under the following heads :—

1. Agriculture.
2. Animal Husbandry and Veterinary Services.
3. Fishery.
4. Irrigation.
5. Communications.
6. Co-operative Societies.
7. Cottage Industry.
8. Education.
9. Social Education.
10. Medical Relief.
11. Public Health.

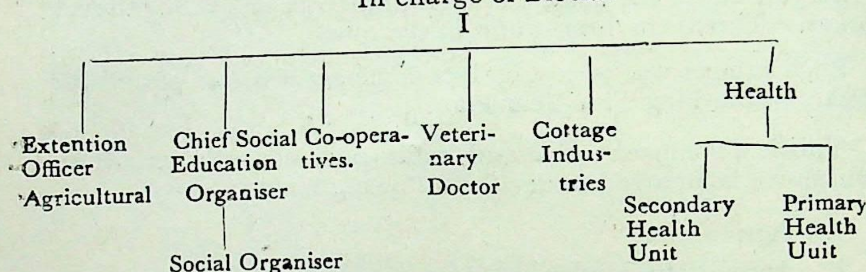
Major emphasis is laid on agricultural development and other productive measures to improve economic status of the people and improve the mode of life of the people.

Organisation and Operation
Central Administration

Planning Commission.
I
Community Project Administration.
I
Administrator Community Project Administration.

Project Administration in the States

Set Up-
I
State Development Commissioner.
I
Deputy Development Commisioner.
I
Distt. Development Officer I Distt. Development Committee
Project Executive Officer. I Project Advisory Committee
I



Village Level Workers

Village Committee. Village Clubs. Village Welfare Bodies.	Gram Sewaks and Gram Sevikas

The Key man of the whole set up—Village Level Worker or Gram Sewak,

Health Programme :—There is a provision of one Primary Health Centre in each block. This health centre is the focus, from which health activities radiate into the interior areas. Emphasis is laid on preventive measures along with the provision for treatment facilities. Each such health centre has a dispensary and an indoor ward of six beds. A maternity and child welfare centre is attached to this centre. The services provided are :—

1. Medical Relief.
2. Maternal and Child Health Work.
3. Environmental Sanitation.
4. Health Education.
5. School Health Work.

Staff of the Primary Health Centre :—It consists of the following :—

1.	Doctors.	2 (one for mobile unit)
2.	Compounders.	2
3.	Sanitary Inspectors.	2
4.	Health Visitors.	2
5.	Midwives.	4
6.	Trained Dais.	6
7.	Cook.	1
8.	Sweeper.	1

The whole staff will work as a team. The health work mainly concentrates on preventive measures rather than on curative measures. The midwives and dais are to live in selected

places close to the people. The mobile doctor will open sub-centres in the different parts of the block and will keep open viilage medicine chests with the gram-sewaks.

Secondary Health Centre :—There will be one for each project at the project headquarters, with a hospital of 40 beds. It is also the supervising centre for the block primary health centres.

Staff of Secondary Health Centre :—It consists of the following :—

1.	Administrative Medical Offieer. with public health qualification	1
2.	Assistant Public Health Engineer.	1
3.	Malaria Inspector.	1
4.	Senior Health Visitor.	1
5.	Medical Officers (Men),	2
6.	Lady Doctors.	2
7.	Laboratory Technician.	1
8.	Clerk.	1
9.	Steno-typist.	1
10.	Compounders.	2
11.	Cooks.	2
12.	Sweepers.	4
13.	Nurses.	4
14.	Anti malaria staff.	6

On second October 1952, fifty-five such community Development Projects started functioning.

National Extension Service Blocks :—When the rural public saw the success of these community projects, there was a great demand for such projects. In 1954, National Extension Service Blocks were created as the resources were limited for the increase of the wealth of the country by improving agriculture and allied productive activities. The blocks have now become a permanent feature of the development programme of our country. The objects of this movement are the same as that of Community Development Programme.

Staff :—of each block is as follows :—

1.	Block Development Officer.	1
2.	Extension Officers. — Agriculture. Animal Husbandry. Co-operative & Panchayats.	3

3. Social Education Organisers. 2.
   (1 male and 1 female).
4. Overseer with Public health bias. 1.
5. Village Level Workers. 10.

Finances :—In the first Five Year Plan, 700 blocks under Community Development Project and 1200 National Extension Blocks were provided with a budget provision of 101 crores.

By the Second Five Year Plan (1961), it is proposed to cover the entire rural areas of India. It needs 5,000 such National Extension Blocks for this purpose.

CHAPTER XX

SOCIAL MEDICINE

Social Medicine is the latest comer in the field of medicine and is still in the early phases of its evolution. Its boundaries are difficult to fix, so as yet, proper and suitable definition has not been framed.

Gladston Says : "It has carried and now carries different meanings to different persons. To some it means social pathology, the art and science of studying disease in the social group or the community with the same techniques, which medicine has hitherto utilised in the study of disease in the individual. To some, social medicine means an extension or public health, to embrace social factors of communal health, such as housing, recreation, school, luncheons and mental hygiene.

There is a small and energetic group which sponsors the idea that social medicine is to be achieved in conjunction which medicine and social sciences. There is still a smaller group that looks upon medicine as the embodiment of a new-old philosophy bearing on man's position in and relation with world about him. This group considers the modification of medical education, in accordance with the fundamentals of essential ecological philosophy, a fundamental pre-requisite to the realization of social medicine.

For the proper understanding of this science, it will be better to know the definitions which are given by different authors to the terms such as Preventive Medicine, Public Health, Social Medicine and Hygiene.

In 1920 Professor Winslow described "Public Health as the science and the art of preventing disease, prolonging life and promoting physical and mental health and efficiency through organised community efforts, for the sanitation of the environments, the control of community infections, the education of the individual in principles of personal hygiene, the organisation of medical and nursing services for the early diagnosis and preventive treatment of diseases and the development of the social machinery which will ensure to every individual in the community a standard of living adequate for the maintenance of health."

In 1932 M.F. Boyd said ; "Preventive Medicine may be defined as the branch of applied biology which seeks to reduce or eradicate disease by removing or altering the responsible etiologi-

cal factors. Included within its scope are two subjects which are often confused within its ; these are hygiene and sanitation respectively. Hygiene is the proper care of the body, to permit the normal functioning of the various organs and tissues, while sanitation is the proper cleanliness of the environments."

Prof. Warren says : "Preventive Medicine consists of two distinct phases, the protection of the health of the individual and protection of the health of the community."

Leavell and Clark in 1953 in their text-book of Preventive Medicine say : "This subject is broader than merely the prevention of disease. Medicine must also be concerned with promoting health and with the prevention of total disability, by rehabilitation of those damaged by the disease process. The term "preventive medicine" is widely used and generally accepted and we propose to employ it here in a sense sufficiently broad to include both health promotion and rehabilitation. Much confusion has arisen between the terms "preventive medicine" and "public health"........Attempts to differentiate these terms by definitions alone are likely to confuse further, than enlighten. It is better to consider first on the one hand, how a public health officer practises preventive medicine and how, on the other, the private practitioner applies it. Both are practising preventive medicine as we propose to use the term, but their points of view and emphasis differ in many respects." They further add : "The preventive medicine is the science and art of preventing disease, prolonging life and promoting physical and mental health and efficiency. This definition applies to preventive medicine as practised by either the private practitioner, dealing with his individual patients, or the public health officer with aggregations of individuals in his community. Public Health may then be considered a sort of division of preventive medicine, the part of which requires organised community effort or action.

Dr. Gladstone says : "Preventive medicine is divisible into two departments-Communal preventive medicine and personal preventive medicine. The former is largely the province of the sanitary engineer, the chemist, the epidemiologist and public health officer. Personal preventive medicine is primarily a function of the private practitioner, dealing with individual patient. Communal preventive medicine (Public Health) is highly developed and has a record replete with accomplishments."

Wilson G. Smillie in 1952, in his book on Preventive Medicine and Public Health says : "I have made a distinction between preventive medicine which I consider as a function of the individual in promotion of personal and family, health, and public health as a community function. The author may be accused of

hair-splitting, sophistry, since there is an overlapping of these functions, with no clear-cut distinction between them. But I believe that the distinction is a valid and useful one, and that it will be found to be most practical in organising the instruction of the students and in planning teaching programme with departments of clinical medicine.........Public health encompasses those activities that are undertaken for the prevention of disease and the promotion of health which are primarily, a community responsibility. These activities may be carried on by an official department of public health, by voluntary health promotion agencies by department of education, by state or country medical societies or other community agencies......The physician should be thoroughly familiar with the need for these activities. He should participate in them, but they are not his direct responsibility...... Preventive Medicine encompasses those activities, that are the direct responsibility of the individual in the prevention of disease and in protection and promotion of the health of himself and his family......Who is responsible for the proper conception and execution of these activities ? They fall, for the most part upon the family health advisor. Usually this person is the, private physician, who aids and guides all members of the family in all matters pertaining to individual health protection......Preventive medicine, then represents individual responsibility for activities that are carried out, for the family as the unit. Public Health represents a community responsibility which is carried out for community benefit. In the first instance the family is the unit for consideration.

As per report of Interdepartment Committee on Medical Schools in Great Britain, the term Social Medicine includes the more restricted, though very important, subject of disease prevention. It also signifies a particular conception of medicine, a conception that regards the promotion of health as a primary duty of the doctor, that pays heed to man's social environment and heredity as they effect health and that recognizes that personal problems of health and sickness may have communal as well as individual aspects."

According to Fred Grundy the term Social Medicine has no settled meaning but it essentially signifies three important facts :-

1. That most of the diseases have a Social origin or can conveniently be regarded as due in part to social causes.
2. That disease has social consequences and often requires social services as well as medical care services in any complete therapeutic programme i.e., social remedies are often needed as a part of therapy.
3. That social services are often needed along side medical care services in order that sick persons may use the

latter effectively e.g. provisions for the care of young children, while with a toxaemia or other condition is admitted to hospital for treatment.

As a subject of study, the term Social Medicine comprised the following :—

(i) The Agencies of Social Therapeutics

(ii) An aspect of epidemiology concerned particularly with research by means of surveys and statistical investigations into the Social and genetic factors which affect health and the incidence of disease.

(iii) The reciprocal relations existing between medicine and Society.

(iv) Social psychology and Social Psychiatry.

Dr. John A. Ryle started the first department of that name in 1942, by calling it the Institute of Social Medicine at Oxford. He published a memorandum, when this institute was opened giving the purposes of Social Medicine which were :—1. To investigate the influence of social, genetic, environmental and domestic factors on the incidence of human diseases and disabilities.

2. To seek and promote measures, other than those employed in the practice of remedial medicine, for the protection of individual and of the community, against such forces as interfered with the full development and maintenance of man's mental and physical capacity.

3. If required by the university to do so, to make provision in the institute for instructions in social medicine of students and practitioners of medicine approved by the board of the faculty of medicine in the University of Oxford.

According to Dr. Ryle : "Social Medicine embodies the idea of medicine applied to the service of man as *socius*, as fellow, or comrade, with a view to better understanding and more durable assistance of all his main and contributory troubles which are inimical to active health and not merely in removing or alleviating a present pathology. It also embodies the idea of medicine applied to service of *societas* or the community, of men, with a view to lowering the incidence of all preventable diseases and raising the general level of human fitness. It is concerned with scientific disciplines and improvement of preventive and remedial practices based thereon and not with political planning."

The main difference between the term Public health and the so called Social medicine are :—1. Public Health, although in its modern practice, attaching an ever-increasing importance to personal services for a long time places the emphasis on the environment. Social Medicine deriving its inspiration more

from the field of clinicial experiences the emphasis on man and endeavours to study him in relation to his environment.

2. Public Health has been largely preoccupied with the communicable diseases. Social Medicine is concerned with all diseases of prevalence, including peptic ulcer and rheumatic diseases, cardiovascular disease, cancer, the psychoneurosis, and accidental injuries all of which have their epidemiologies and their correlations with social and occupational conditions and must ultimately be considered to be in greater or lesser degree preventable.

3. Where hospital practice is concerned social medicine properly takes within its ambit the whole work of the modern almoner's department : this includes social diagnosis and social therapeutics, the investigation af conditions, the organisation of after care, and the readjustment of the lives of the individuals and families disturbed or broken by illness. In British Journal of Social Medicine, it was published that social medicine is that branch of science which is concerned with:—(a) Biological needs, interactions, disabilities, and potentialities of human beings living in social aggregates.

(b) Numerical, structural and functional changes of human population in their biological and medical aspects. To a large extent its methods must necessarily be statistical involving the use of numerical data obtained from official sources or from special field investigations and interpretted in the light of established findings of the labortory and clinic. Social medicine takes within its province the study of all environmental agencies living or non living, relavent to health and efficiency, also fertility and population genetics, norms and ranges of variation with respect to individual differences and finally investigation directed to the assessment of regimen of positive health."

Crew says: "Social Medicine" is the new name of that academic discipline known variously hither-to as state medicine, public health, preventive medicine, or hygiene. The name is changed because the theoretical basis, the content, the scope, the instrument and the aims of the subject have been under-going marked alteration. These have changed because social values, aims and needs have, with the passing of time and the continued evolutionary development of society itself, undergone profound modification.

Therefore, social medicine is now taking the place of public health in the curriculum. But as yet its content, scope, and relationship to other branches of medicine remain somewhat undefined and in the different medical schools the direction of its present development is not the same.

"The content of social medicine consists of the medical aspects (health, happiness, efficiency) of human and social biology and human ecology. The laboratory of social medicine is the organised community (the country or the region, the city) and within this, the community and health centres, in which the problems of social physiology, pathology and therapy are clearly to be seen and the technique of these sciences exercised. The raw material of social medicine consists of records. The human animal cannot be used deliberately as an experimental material in controlled experimentation. He is unique however in that, his behaviour records can be and are maintained. The investigational instruments of Social medicine are biostatistic and field investigational teams. By means of these, records are collected and the knowledge contained therein is distilled. The therapeusis of social medicine is not medical but social and political action based upon medical recommendations......For this reason Social medicine must be exceedingly active in the field of health education, the education of the citizen and of the politician,, local and central.

"Social Medicine rests on the twin pillars of medicine and social sciences. Within its ranks therefore there must be included not only representatives of medicine but also those of the other sciences which deal with the different aspects of human ecology. Teaching and research in social medicine are not endeavours to be undertaken by the individual, but by an integrated team."

"Social Medicine is the result of the transformation of public health into social science and medical science in relation to groups of human beings."

Greenwood describes Social medicine as :—"The application of medical and scientific knowledge to the prevention and relief of suffering, and to the raising of the standard of living which can only be affected by social agencies and by co-coperation." "It may be described as a subject with many facets and as our knowledge is expanding and resources are increasing each of these facets is becoming a vast subject by itself."

Edward, J. Steiglitz writes :—"Social Medicine is concerned with man as a member of society. Social Medicine deals with health enmasse; we may contrast the two fields (social vs. clinical medicine), as whole-sale versus retail. Social Medicine is public health maturing."

Ffrangeon Roberts says:—"By Preventive medicine or Public health is meant action by State to secure conditions favourable to the prevention of disease. This conception has recently been expanded to include the study of the effects of home and factory conditions, known respectively as Social medicine and Industrial

medicine. The need for Social medicine has arisen, because of the fact, that for efficient investigation and treatment the diseased person has to be taken out of his environments and placed in artificial surroundings of a hospital. Every general practitioner has of course the intimate knowledge of home conditions and rarely fails to take them into account. The specialist for his part, while enjoying the advantage of dealing with large numbers of a particular disease labours under the dis-advantage of having no experience of home conditions. We therefore have one branch of the profession, intimate with environment but not with disease, the other intimate with disease but not with environment. Social Medicine aims at remedying this dichotomy by combining the intensive study of disease with field work.

Col. P C. Dutta writes: "There is still considerable confusion concerning the scope, content and the aims of Social medicine. It may be described as the study of those environmental factors which affect health, and the application of that study to the benefit of man with a view to prevention of disease and promotion of health. The term environment is used in its very widest sense, to include not only the physical but aslo the social environment, it includes also the study of heredity in relation to human health."

"Social Medicine embraces on the one hand, the whole of the activities of the public health administration and of the remedial and allied social services, and on the other hand the special discipline necessary for advancement of knowledge relating to sickness and health in the community."

In the report of the Medical Curriculum committee of the British Medical Association entitled "The training of doctor" the following is said about Social medicine and Public health:— "Recent years have seen an increasing recognition of the broadening horizon of Public health. The conception of Public health has come to cover not only the traditional study af environmental conditions and communal health but the whole problem of Preventive medicine and the back ground of disease, The term "Social medicine" is often prepared as a truer deseription of the content of this branch of medicine. Social medicine which is concerned with the place of the individual patient in his environment, offers a more profitable study to the undergraduate than to do some of the topics in the existing public health course. Many topics are of course common to both public health and social medicine but the whole subject as taught to the medical student needs to be completely reorientated."

Canby Robinson, a pioneer in the field of Social medicine discusses illness in contrast to disease. He defines "illness" as a

state in which certain natural functions are so disturbed that the patiént connot meet the usual requirements of life so distinct from "disease" which is an abnormal state of the body resulting from harmful effects of process, injurious substances or accidents. As such, disease is only one element of illness. Disease does not necessarily cause illness and the illness may exist without disease. Physiology, chemistry and biology do not explain all the intricacies of illness. This is brone out by the following findings of a study of unselected cases admitted to the John Hopkine's Hospital:—"Adverse social conditions had a definite relation to the illness of 65 percent. These conditions caused harmful emotional effects in 58% of the patients and 20% produced emotional reactions that were considered to be the chief cause of the illness. In 15.5% of cases a study of the state of their social situation furnished significant and essential information for the complete diagnosis of their illness. It is becoming increasingly evident that not only illness, but also many organic diseases have their origin in social, domestic, or industrial maladjustment. Economic insecurity or dietary insufficiency, necessitating a reorientation of existing preventive medicine and public health and creation through right type of health education are a part of broader general education of a public able to participate in the fullest human well-being.

Formerly the communicable diseases were considered to be due to pathogenic organisms. Now stress is laid on the socio-economic circumstances. Diseases are not only caused by micro-organisms but also by social conditions. It is also evident that not only illness but many organic diseases have their origin in social, domestic or industrial maladjustment, economic insecurity or dietary insufficiency. It is also a fact that the incidence of disease, accidents and injuries is much greater among the poor than among the rich. This shows that there is a close relationship between financial welfare and ability to prevent disease. The other factors which adversely affect health are ignorance, illiteracy, superstition, mysticism etc.

It often happens that the personality of a patient tends to be lost in the highly specialised and complicated organisation of medical services as it exists today. The sick man comes to the doctor with family ties and other human interests and responsibilities. The patient may not suspect and the doctor may not realise, how the pattern of this and his environments affects his illness but thorough review of his life and living conditions may sometimes let in a considerable light on problem of diagnosis and treatment of his illness.

For the new situation, there is a demand of the services of medical practitioners, and medical men whose training should be

reorientated to include sociology, psychology, economics, physical and social anthropology including biology as well as Social medicine. The existing Preventive Medicine and Public Health should be reorientated, in such a way so as to create, through the right type of health education of public, able to participate in the fullest human well-being. Health is not merely absence of disease, but it is a state of complete physical, mental and social well-being.

Medical care can never be limited to organic impairment, physical illness or handicap, but has to be combined with the treatment of social factors that influence the effectiveness of medical care and contribute to the degree and duration of disability. Increasing consideration of the environmental and emotional influences upon illness has been noted in recent years. The environmental influences may be physical or social.

As Social Medicine depends upon environment, which is completely different in different countries and which is still in infancy in India; research is of utmost importance in the department of Social medicine for which specialised staff will be needed.

Grant (in 1949) has stressed the relative importance of medical and non-medical measures in the practice of Social medicine. It depends apart from medical care programme, on the following non-medical measures:—(1) Social welfare with particular reference to family allowance, training of the disabled maternity benefit and home helps (2) Housing policy based on population needs rather than rental values (3) A national food policy (4) Provision for mental, social and physical recreation through community centres and educational measures for the development of health consciousness.

Sir Arthur says: "Social Medicine, as it is termed, is not a new thing. It is an integral part of preventive medicine. What needs to be more fully realized, both by medical profession and by the public, is the wide conception of preventive medicine. The purpose of this science and art is application of knowledge to the prevention of disease."

Sir Farquhar Buzzard considered: "Social Medicine as the union of remedial and Preventive medicine. He recognised that there were some, indeed many etiological factors of disease and disability which neither Clinical Medicine nor Public Health embraced, in their respective sphere of knowledge and which are their discovery or exposition required new techniques and new instruments". He was the first to advocate the creation of autonomous department of Social Medicine. He believed that the time had come when Preventive medicine should possess like remedial medicines certain centres of research staffed by men

and women giving their wholetime to the solution of number of problems, many of which at present moment seem to be nobody's business. "They should be closely associated with the university medical schools on the one hand and the hospitals or groups of hospitals on the other, the former providing for research and the latter the access and key to material." In Social Medicine, one has to "enlarge the field of vision" and to broaden "etiological study."

Prof. Hobson professed to "regard Social Medicine as a philosophy which should permeate all branches of medicine, for its implications cannot be divorced from any branch of medical learning. It is a branch of medicine also which provides a connecting link with the wider humanities. He considers Social Medicine as the study of man within his environment to give him life and to give it more abundantly."

Galdston says : "Social Medicine is frequently confused with socialised medicine, yet the two are worlds apart. Socialised medicine envisages the perpetuation of current medical thought and practice, while Social Medicine their radical reform. In the current situation, they are antagonistic and not similitudes. Socialised medicines are modes in the application of medicines; these are organisational schemes for the distribution of medical services. They have been cultivated under the compelling impulsions of social, rather than economic potential and ideological changes in society. But Social medicine is primarily a derivative of the progress of medicine itself. It represents a maturation of medicine, the attainment of a new high point. It is not easy to draw a line of distinction between Preventive and Social Medicine. According to Fred Grundy, the enlargement of preventive medicine by the introduction of personal hygiene and health education and promotive services has gone some way in making Social Medicine as synonymous. But, however it can be said that Preventive medicine is primarily concerned with the immediate physical causes of disease, whereas Social Medicine attends mainly to the circumstances which favour the incidene of disease.',

"Hitherto the medical students' attention has been directed almost entirely to the diagnosis and treatment of disease and mainly of established disease rather than of early und slight departures from health which if ignored or neglected may lead to establishment of disease.

"The majority of physicians and surgeons have curiously little concern with etiology of disease—the first essential for prevention. At present neither the opportunity nor yet the appropriate type of training or assistance requisite for the study of

etiology or prevention of disease are available. Their material is mainly selected for four factors, the gravity, the difficulty or rarity of their cases or their suitability otherwise for admission to a hospital. Some of the most common diseases, the less lethal diseases and the beginning of the disease are even considered as providing poor teaching material. Health and sickness in the population and their possible correlations with significant and measurable social or occupational influences are outside their province.

"We are still as a profession thinking more about curing than preventing, more about medical care and its huge costs than about the economics which could be affected by attacking the basic causes of disease."

Social Medicine in England:—The agitation of Social Medicine was first initiated in England about a century back. Later on in America it was called Socialised Medicine and in Germany as *sozial medizine*.

Why England took initiative in social medicine? Whatever may be the reasons, it was derived from the social necessity rather than inspiration of certain ingenious men. About a century ago, there came sanitation movement in England in reaction to social and ecological bye-products of industrial revolution. The misery of lower classes, the degrading slums of manufacturing towns and cities, the pitiless exploitation of women and children, the ignorance, squalor, disease, corruption that resulted from and were witness to the social, economic and cultural dislocations incidental to change from agrarian craft economic to one of the capitalist machine production, stirred many people to awareness that human life, labour, power, and the other important elements in national wealth, were being squandered in the persuit of selfish and immediate profits. There was naturally a general protest against it. Sanitation movement was a part of this protest. It was directed to the betterment of physical environmental, hygienic conditions under which people lived and worked. The State Government also came to know of its responsibilities for the health and care of people. Several social reforms as accident prevention, compensation to injured workers, limitation of working hours etc. were consequently made.

But sanitation movement lost its way to bacteriology, when bacteriologist told the world that diseases would be eradicated from the world within a short time. In the advent of modern medicine in the later half of last century, medical practice grew tremendously and dazzled the scientific and lay worlds. But certain events and experiences quickened the embryonic movement of Social Medicine." Sir Wilson Jameson gave a discourse

on war and advancement of Social Medicine. Medical Research and enquiries made by the Royal Commission of Physical Training (Scotland 1903) the interdepartmental committee on physical deterioration 1904 and a departmental committee on medical inspection and feeding of children attending public elementary schools in England in 1905, created a profound impression on the hearts and minds of the public, and paved the way for the birth of Social Medicine in England.

Social Medicine had feeble growth during next decade. Then came the First Great World War of 1914—18, in which entire population, *viz*, military and civil was involved in wide strains and stresses. Many, so far imperceptible deficiencies cropped up. Great improvement was made in all walks of life. Various branches of service showed rapid progress the advancement of which was, however hampered on account of economic depression, unemployment, evermounting threats of various other post-war problems.

Various individual and collective remedial schemes were drawn up by ingenious men, the result was rather socialised medicine in the form of Britain National Health Schemes instead of Social Medicine. Many other schemes for the improvement of public health services were initiated for children, mothers, infants, and treatment of venereal diseases, tuberculosis and industrial hygiene. By enforcing "A National Hospital system," Government provided public medical service for people which they were incapable of providing for themselves individually. But strictly speaking this was again not Social Medicine.

The movement of Social Medicine is essentially a derivative of Second World War. Socialised medicine being a bad medicine was replaced by Social Medicine.

According to Ryle "Social Medicine" is concerned with seientific diciplines and improvements of preventive and remedial practices based thereon and not on political planning."There are two points of views, *viz.* humanitarian starts with the individual as a member of community and finds the duty of Social Medicine to serve him directly as such. It tells the doctors that the patient is not collection of phenomenon of morbid anatomy but a human being with a place in society. The other view is scientific, *i.e.* study of group by statistical methods without particular reference to individual cases and determination of social etiology and repercussions of disease as mass phenomenon.

Training in Social Medicine in Medical Education :—Ryle wrote, "In teaching of our students, in our researches, in our recommendations of policy, we have need both for a new idealism and a new realism. We can no longer remain content with many of the old conventions of our text books and examination which have

changed but little in form and manner in a generation, although they have multiplied both in their imposition and number. We no longer believe that medical truths are only chiefly to be discovered under the microscope, by means of the test tube and animal experiment or by clinical examinations and increasingly pothological studies at the bed side. Psychological and sociological studies have an important part to play. Even so, it is not yet appreciated, how intimately disease and social circumstances are interrelated. The whole natural history of the disease, in human communities as well as in individuals is ripe for the fuller and more exhaustive study." In all medical colleges in India, a department of social and preventive medicine should be established under the charge of a whole time professor, who should be assisted by an assistant professor, and a medical officer of health who is in charge of a fully organised rural health centre. In this centre there will be a health educator, a public health nurse or a lady health visitor, sanitary inspectors, assistant surgeons and a public health engineer.

In addition to the provision of laboratories in basic subjects in medical colleges and the clinical section of the teaching hospitals, laboratories should be provided with controlled urban (200,000 population) and rural (500,000 population) community fields for the investigation and the teaching of Social Medicine.

The essential features for integrating Social Medicine in medical education are the theoretical, practical and the social aspects, with the end that the aim of instruction should be (a) to industrial and social factors and accompanying problems which disrupt the normal functioning. (b) to train the students in the practice of social investigation to enable him to use the appropriate social technique in the planning for therapy or after-care based on the realities of each patient's social as well as medical needs. (c) To bring into contact the students, with various public and private welfare and social agencies together with remedial organisations so that he may learn how these are prepared to co-operate with the medical practitioner or doctor in the care of the patient.

The British Medical Association in their report of the Medical Curriculm Committee, "The training of a doctor 1948" has recommended a teaching programme which is suitable in medical school groups. The first group of subjects will serve as an introduction to the study of Social Medicine, to the concept of Preventive medicine and to the emotional aspects of the diseases. In the second group of subjects the teaching will coincide, as nearly as possible with the appropriate clinical teaching and the instructions will be given during the second clinical year. The teaching of Preventive and Social Medicine should spread

throughout the 5 years of under-graduates' medical studies. Their details should be as follows. The number of hours may be varied according to the discretion of the professor who is head of the department :—

		Year	Hours
1.	Introduction to Preventive and Social Medicine	I Year	5 Hours
2.	Medical Statistics	I ,,	3 ,,
3.	Health and Nutrition (a) Food and Nutrition, Dietetics (b) Malnutrition and Deficiency diseases	II ,,	8 ,,
4.	Physiological Hygiene, Air, light, sunshine.	II ,,	5 ,,
5.	Environmental Hygiene	III ,,	25 ,,
6.	Epidemiology and Communicable diseases	VI ,,	35 ,,
7.	Industrial Hygiene	IV ,,	5 ,,
8.	Maternal and Child health	V ,,	5 ,,
9.	School Hygiene	V ,,	5 ,,
10.	Health Education	V ,,	4 ,,
11.	Mental Hygiene	V ,,	2 ,,
12.	Public Health Administration	V ,,	2 ..
13.	Social Medicine	V ,,	6 ,,

The recommendations of the committees and conferences held, to reformation in the teaching of Preventive Medicine are :—1. The contents of the medical curriculum should bear a direct relationship to the needs of the country.

2. The training of the "basic" doctor should include, as an inseparable component, education in community and preventive aspects of medicine.

3. The practice of utilizing the services of part-time teachers from local bodies, to teach the subject is not satisfactory. A full time department of Social and Preventive Medicine with adequte staff should be established in medical colleges.

4. The teaching of Social and Preventive Medicine should be spread during preclinical, clinical and internship periods.

5. Preventive Medicine should permeate the whole of medical education. There is no subject of the medical curriculum in which the teaching of some aspect of Social and Preventive medicine cannot be suitably incorporated and there are many specific situations in which the teaching needs to be integrated with other departments.

6. The emphasis during the preclinical period should be on the normal growth and physical and mental development,

adaptation of man to his environment-physical, social and biological and maintenance of normal health. In this period the student should be taught the concept of health and normality, the medical aspect of human ecology, biostatistics and the structure and functioning of the society (social anatomy and social physiology) in which they have to work. The student should be orientated in fundamentals of psychology, social anthropology, sociology, medical economics, historic evolution of medicine and demography.

7. To create a preventive and promotive attitude, students should be inculcated with the importance of preventive and social aspects of medicine. Preventive methods, applicable both at individual and community level, should be an important part of the teaching of medical students.

8. Clinical conferences may be held during the preclinical period, in which cases selected to illustrate social origins of disease and multiple causation may be presented once a month in co-operation with other departments. The conference should be essentially of a "preclinical type, *i.e.* mainly concerned with the diagnosis of the circumstances and the condition of the patient rather than with his disease. In the final analysis the chain of infection or causation showing points where this chain could have been broken and the disease prevented has to be brought out to stimulate the thinking of the students in terms of maintenance of normal health, social causes operating in disease and need for early prevention, detection and treatment.

9. The student during his training should act as family adviser of one or two assigned families with a mother and a growing child and a chronic case. He will thus receive, through prolonged association with the family an intimate understanding of the relation of health and disease to the total family, and appreciation of the importance of maintaining optimum health. He will also learn to assume responsibility for creating and maintaining support with the family so that he develops the basic concept of a "social physician protecting the people and guiding them to a healthier and happier life."

10. It is very important that students come in contact with the living conditions of the people, so that they may know them and their importance in the causation and spread of disease. As over 82 per cent of the people live in villages, it is desirable that students should spend about 33 per cent of the total training period in the subject of social and preventive medicine on field studies in a rural health centre, preferably situated in a community project. This will promote in students a community outlook, will enable them to interpret health and disease in relation

to social background of the life of the people and will help them to understand rural health needs. The student should also be able to understand that improvement in community health is mainly due not to what is done when people are ill, but to the fact that they do not become ill when the environment in which they live is healthy.

The necessity of the department of social and preventive medicine having a rural health centre for investigation and teaching is analogous to the provision of laboratories and hospital beds for teaching of other disciplines.

Preventive Routines in the Outdoors and Indoors of Teaching Hospitals :—They are under an officer of the department of the preventive and social medicine of the college, generally the assistant professor who is detained specially to the hospital to supervise the cases and the students.

All patients coming from the controlled urban area are issued record forms of a special colour, in order that the students and hospital staff are aware of the residence of patients. The registrar notifies the names of all such cases immediately to the officer incharge of that department.

The reports of the results of any preventive measures taken are sent for and included in the patients hospital record. The out patient departments of large hospitals probably offer most favourable environment for teaching preventive medicine. The main pre-requisties for effective teaching in out-patient department are :—1. A group of influential clinical teachers representing all departments.

2. Facilities for diagnosis and treatment.

3. A close relationship between out-patient department and the social agencies in the community.

4. A close and constant correlation of teaching programmes of several clinical departments.

5. A provision so that each student may be able to attend the same patients over a relatively long period of time.

If the patient is admitted indoor, the staff member gives a preliminary general plan of investigation. The medical clerk, after completing his clinical diagnosis routines and if the case comes under one of the previous designed diseases, goes to the patients home to determine the socio-economic or specific micro-biological and emotional factors or conflicts causing the disease and to prescribe the preventive measures that may be indicated in each instance. This, the student adds to his records of the case. Then onward rounds the students present two aspects of diagnosis as to the clinical condition and second as to the social

etiological factors together with in each instance, the indicated therapeutic on preventive recommendation. Diagnosis and treatment are then commented upon consecutively by the clinician and the professor of social medicine or his assistant.

Teaching activities include *weekly seminars* in which the problems of individual patients are discussed. The seminar is conducted by the staff officer incharge of the students' investigations, professor of Social Medicine, professor of psychiatry, medical social worker and 4 to 6 students and in some cases upto 14 students. The report of the case is presented by the student who investigated it. Each faculty member discusses the situation from his own point of view and questions the student with regard to the various aspects of the case.

The attending student participates in the discussions. The student is expected to follow up his patient and later to file a supplementary report.

In cases of death and autopsy the case is presented at the routine clinico-pathological conference, where diagnosis, etiology and prevention are discussed jointly by the pathologist, clinician and professor of Social Medicine.

Some contact with village life in India has been urged since early years. A technique to accomplish this purpose, which is used abroad and recently initiated in India is described below :— Medical undergraduates are assigned one or more families as medical advisors and in the later years as family doctors. The student visits his family regularly 2—4 times per month, over a period of three years, which may cover the 2nd, 3rd and 4th years of his studies. Thus the student maintains contact with the normal and abnormal members of the family requiring hospital or dispensary care. Record keeping of his observation is an essential part of this scheme. This family doctor plan is supervised by senior staff and such case studies provided material for group discussion. Modifications of this teaching devise are numerous and the number of family assigned and the frequencies of contact may certainly vary. On the whole it can be said that in general this activity has proved an interesting and enlightening mechanism.

In addition to family assignments, it has been advocated that students participate in rural medical and health care programmes for selected communities. In other words a community practicefield is recognised as an essential part of the facilities and responsibilities of department of preventive and social medicine. Participation in health surveys, dispensary care and efforts to meet social needs of a given community constitute together an important part of a student's field experience. To follow up,

selected hospital cases to the home will emphasise for him the preventive aspects of disease. The family investigation of cases of tuberculosis, typhoid, or filariasis, for example, will if adequately planned and supervised bring out the social and environmental factors of disease in question.

This arrangement will also bring a student in contact with various public and private welfare and social societies and organisations. He will learn how and to what extent, they are prepared to co-operate with the physician, in the case of a patient. He will also learn how financial and other helps are arranged and can be arranged by various community organisations.

Health Centre :—Factors like prevention of illness and the promotion of health logically demand a centre in which the family doctor, the preventive health services, and the agencies for socio-medical care can all be grouped together. Tbe concept of this health centre was first placed before the public eye by the Dawson of Penn report in early twenties. It is the only natural vehicle for making Social Medicine available to people. It provides under one roof a focal point for community health activitics which accept the responsibility for the conduct of the six minimum basic health services, viz.,

1. Control of communicable diseases.
2. Environmental Sanitatian.
3. Pubiic Health Laboratory Service.
4. Maternity and Child Health Hygiene.
5. Registration, tabulation and analysis of births, deaths and notifiable diseases.
6. Public Health Educatian.

Its activities are both preventive and curative and the patients will scarcely realise where preventive medicine ends and the curative begins. Emphasis has to be laid on the study of the patient as a whole, and stress needs to be given on study of man in disease instead of the disease in man. The patient has to be treated as a whole and not in segments. The patient needs to be followed into life, instead of on the autopsy table.

Such a centre is usually under the charge of a health officer who is trained in the technique of this new approach to Social Medicine. It places in the field not only an individual physician but also a team consisting of public health nurse, midwives, sanitary inspectors, health educator, laboratory staff etc. This centre may also be visited by a parttime dental surgeon as well as a veterinarian for meat inspection. In big cities, however it is assumed that the health centre will accommodate four to eight general practitioners, serving a population of 10,000 to 20,000 and covering an area of one mile in diameter.

To such a centre an effort is made to secure the periodic attendance of not only the sick, but of all persons in the area. The Centre provides medical care for ambulatory cases. A periodic medical examination is carried out, as a check-up of the community. It provides personal and community preventive service. In rural areas few maternity beds and a labour room are provided for maternity cases and emergencies. Environmental and working conditions are ascertained by interrogation as well as by home visiting and assessment of health or ill health is made in terms of individual, environmental and social pathology. It also serves as a centre for health education and recreation centre on family basis.

Public and voluntary agencies work side by side to provide direct services to individual and families. Financial and other aids are arranged by community organisations.

Definition and Historical Evolution of Society :—The phrase Social Medicine includes two words ; social pertaining to society and medicine. Society stands for (a) *socius* which means fellow or comrade and (b) *societas* which stands for a group or a community of men. Man is a socius in a societas—an individual comrade in the group of community. Individual has two lines of growth (a) developmental and (b) social.

Development begins in the womb of the mother-prenatal. Then there is the natal stage and finally postnatal. The post-natal stage is generally divided into (i) neonatal or infant stage between one month and one year ; (ii) pre-school stage, 2 to 5 years, (iii) school stage, 5 to 15 years ; (iv) Adolescent stage, 15 to 17 years ; (v) adult stage, and (vi) social stage when the individual is an accepted member of a small or large unit of families. The smallest unit is a village or a town. Then a zail, a thana, a tehsil, a district, a state, a nation and finally the world.

An individual who but century ago had a primitive status, in the primitive society of tribal era is now reckoned not merely a member of a family but a member of the world. The problem of the individual is accepted to be the problem of the world. Consequently there has arisen necessity for world organisations like the United Nations Organisations and their Special Organisations like World Health Organisation, Food and Agricultural Organisation, International Labour Organisation etc. National, State and Local Organisations—to extend generalised and specialised services to the individual—These services were created by upgrading the position of the individual, on local, state, national and world level.

Results from recognition and evolution in the value of individual and its relation to a large community :—The relationship is physical, physiological and social—the individual reacts to the society and the society reacts on the individual. Both are complementary to each other. The major functions of a social life defined by an American author are as follows :—

1. Education.
2. Protection of life, property and natural resources.
3. Production of goods and services, distribution of returns of production.
4. Consumption of goods and services.
5. Communication and transportation.
6. Recreational use of leisure.
7. Expression of aesthetic impulses.
8. Expression of religious impulses.
9. Integration of the individual (development of balanced citizenship and service to society).
10. Expression of freedom (political education).
11. Expression of knowledge and adaptation to invention.

"In the perspective every man should have the opportunity to obtain :—

1. Physiologically adequate food for proper growth and maintenance of sound health.
2. Shelter which includes a house, furniture, clothing and sanitary environment.
3. The opportunity for developing positive health and physical fitness.
4. An education suited to his abilities and adapted to his requirements of national and world citizenship, along-with facilities for fostering a spirit of explanation and adaptations to inventions and the chance to develop his leisure and in retirement to extent which the wealth producing capacity of his country for the time being can offer."

This course visualises full social production, full social distribution and full social utilization for the progressive development of individual and society.

Historical Evolution of Physician and medicine :—The profession of medicine implies service of mankind. Since the dawn of civilisation, medicine is a profession for relief of diseases, but the relief was based on the conception of the cause of diseases, prevailing social customs and economic structure of the society.

To begin with, at the dawn of humanity, disease and disability were attributed to supernatural causes such as the wrath of the gods and possession of by demons.. So the treatment

was directed to the appeasement of the God, like sacrifice offerings, worship, etc. Therefore in primitive society the physician was the medicine man, priest and magician in one person. This person was a mediator between world of man and the world of spirits and gods. In the Rig Veda (2000 B.C.), references have been made to such physicians.

In the later period i.e., in the period of Yajurveda (1000 B.C.) or in the time of Ebers Papyrus (1600 B.C.), there was a splitting up of this complex personality and the priest, physician and the magician became separate persons, but the temple medicine also persisted and even now in our present day civilisation it tends to exist.

Simultaneously and at later stages, the disease was thought to be due to sins, disobedience to natural and religious laws, crimes or vices and accordingly the cure prescribed was the atonement or appeasement of the gods by sacred wash, or holy-bath, almsgiving, fasting, etc. The priest who practised religion carried out this function for a long time.

At a later stage especially in India and Greece the cause of disease was attributed to a natural process the result of the action and reaction between the body forces or humours and the environment. Thereafter, scientific medicine started and developed with observation, description, inferences, experiments and recorded facts in the hands of Agnivesa, Charka and Susruta in India, Hippocrates, Aristotle, Galen in the West Avicenna Rhazes in Persia. Unfortunately in India, medicine stagnated after Charka and Susruta.

Later on Madhava came into the picture. From 800 A.D. onward many works on the subject were written by Vagbhtta Chakrapani Bhabamisra and Sarangadhara. They are merely commentaries and elaborations on the previous works of Charka and Susruta. Further progress and development of medicine was confined to the Caliphate empire and the West. In the last two centuries the progress has been so spectacular in the West that we are now in a position to prevent many of the diseases and their ravages and increase the life span of man, although due to foreign rule in India not much progress was made in the indigenous system of medicine.

The earliest priest physicians of Rig-Vedic age were held in great esteem. The early Greek physicians, the Asclepiads, ancestors of Hippocrates considered themselves descendants of Asclepios the hero of health. They were laymen but they had learnt the art of healing. They needed to practise their craft by moving from place to place, like similar roving healers in our country in the same period specially the Buddhist monks.

The same practice even exists today as we find wandering medicants as well as mobile dispensaries and units, in many states. In Greece these healers had their shops and they also used to go from place to place. They used to charge fee, so their position in society was not very high, but they were better respected than other artisans. In India and Persia during the same period, the physician was held in high esteem, but the surgeon did not command much respect.

In Rome the healers were slaves at first and high price was paid for them. About the 3rd Century B.C. Greek physicians began to migrate to Rome as they were considered superior and more efficient. Some of them were engaged in the army.

Surgery started, as dealing with the extraction of foreign bodies by the barbers, known as Shalyashastra. It did not command much respect in the beginning, but later it occupied an important position in medicine and was called the mother of surgery. In India in early days, Dhanwantri learnt the art from Indra ; reincarnated in Benaras and taught Susruta Surgery.

In India and in many other countries, the institution of king's physician was as old as kingship itself. His tent was next to king's in the battlefield. In many countries, he had to certify the king's food before the king would eat it.

During the Brahmanic period, the physician was respected but there were already Kuvaidyas or Kuhakas (from which the modern term quack is derived), was increased in number ; Charak describes two kinds of physicians the true and the false.

During the Samhita period the status of the physician went very low. "Food offered by a therapeutist, an ungrateful person etc., should not be accepted" (Manusamhita). It became a mere craft descending from father to son. There was a general decay in the cultural and scientific progress. It went on deteriorating till about the time of Charak.

At the time of Charak and Sasruta the social position of the physician was fairly high. He was much respected. While this was going on in India, in Caliphate empire medicine grew and developed in the West, and the physician held an important place in the court, society and church.

In India owing to the foreign invasions and domination, no progress was made in the advancement of medicine. The physician was not held in the same social position as in other countries, nor was he given any opportunity or facility to improve his knowledge, to do research in his science or for the betterment of the public. On the contrary the Western countries

have done a lot in this direction and have given a lead to the world.

Remuneration of the physician :—In the early days the physician was paid according to the success of the treatment, either in cauri shells or kind. In the code of *Hammurabi* (200 B.C.), a physician's tariff is seen, in which the amount is charged according to the position of the patient. Thereafter the remuneration was paid to the physician according to the result of the treatment. This was not considered satisfactory as in many cases inspite of the best efforts, the disease proved fatal. Thereafter he was paid according to his efforts, the system which is more or less present in these days.

Even in Rig Vedic times the medicine was practised as a means of livelihood.

In Charak's (200 B.C.) period medicine was assuming a social character. Charak laid down a principle that the physician must treat free the poor, the helpless and the Brahmin. It was for such patients as were poor, could not pay for their treatment, lost their earning power through illness, etc., that a number of charitable institutions were opened in the middle ages. At that time the medicine was practised not only for gain alone, nor was it always free. It was practised for acquiring religious merit as well as for the sake of monetary gain. At that time the practice of accepting rewards or gifts by the physician after recovery from illness and after child-birth had also started.

If there was any disagreement, regarding fee, between the physician and the patient, the matter was referred to a committee of experts, according to the ruling given by Kautilya's Arthasastra.

During the end of the last century, due to industrialisation, the needy population increased tremendously. Moreover the medical aid had become very expensive, due to costly drugs and injections coming into the market. This difficulty was surmounted through the advent of social insurance with the idea of earning a right to assistance in the time of need by one's own efforts in good time.

This system is a great improvement upon the previous one. Many cases of diseases are detected, and attended to, and treated. The physicians are better paid and the sick are properly attended to and adequately treated.

Control of Medical Profession :—The medical profession exercised its control on the behaviour of its members from olden days. In accordance to the code of Charaka and Susruta it, started as the Hippocratic Oath, about 2000 years ago.

During the 19th cuntnry, due to changed circumstances newer codes of ethics were promulgated for the regulation of medical practice, regarding advertising, under-bidding, fee-splitting, taking patients away from a fellow practitioner etc. Later on the World Health Organisation drew up a code of medical ethics and an oath for the medical profession.

Society has always tried to protect itself from the abuse of physician's power by establishing st ndards of medical behaviour. These have their origin in three different spheres *viz.* :—

1. Individual conscience of the phys cian who should refrain from things which he considers wrong.
2. The Government, which protects the legal claims of the physicians as well as the the Society against abuses of medical profession guarding petients' secrets and making the physician liable for damage due to negligence.
3. The medical profession who sees that its members maintain the dignity and traditions of the profession.

Registration of Physicians :—In very early days physicians were not licensed, so that any one could practice medicine. But it is mentioned in Charka that a physician could enter to profession, after obtaining the king's permission.

In Rome the number of physicians was fixed. Antonius Pius fixed, that not more than 5—7 physicians be allowed to practise in a city. The number depended upon the size of the city. They were also required to obtain permission before starting pratice.

Similar restrictions were also imposed in other countries such as Egypt. Calif-Al-Mugtadir (931 A.D.) allowed only those to practise in Bagdad who had been examined by Sinam Ibn Thabt. In the West in the middle ages, when universities came into existence medical licensing system was introduced.

The first Medical Registration Act was passed in England in 1858 and the General Council of England was formed.

In India in 1898, a directory of qualified medical men was published. A few years later a register of qualified medical practioners in Bengal was published. This was followed by the passing of Medical Registration Act in 1912 in Bombay.

Now the State Governments are enforcing acts in the respective states for regulating the practice of medicine, in different systems of medicine and registering these practitioners.

STUDY OF SOCIAL MEDICINE

In the study of general medicine, one has to deal with anatomy, physiology. pathology, diagnosis and treatment. Similarly

in the Social Medicine in the same order are social anatomy (structure) social physiology (function), social pathology (disfunction), social diagnosis and social therapeutics. Social anatomy, physiology and psychology extends into the field of anthropometry—social pathology and clinical study deal with etiology and diagnosis. Social diagnosis covers socio-medical demography (Statistics and surveys).

Social Anatomy :—It deals with land and its people, climate, age, structure, martial, status, pattern. religion, language, economic stratification. national and per capita income, working force, pattern of rural economy, cost of living, agricultural area, soil, rainfal, irrigation, industry and commerce, transport, educa. tion, labour etc. Besides these births, immigration, emigration, census registration, population increase or decrease, population structure, distribution by sex and age groups. come under it.

India is a vast country. Its area is 12,69,640 square miles, comprising of several states. It is the seventh largest country in the world, 13 times as large as United Kingdom and 8 times the size of Japan; 1/3 of Canada and 1/7 of U.S.S.R. Its climate is tropical. Its mineral reserves are :—iron ores, manganese, chromite, ferro alloys, non ferrous metals, mica and salt. India is the world's most populous country. Its first census was taken in 1881 and since then it is taken after every 10 years. The population of India according to the census in 1951 was 356,829.485 of which 183,309,645 are males and 173,523,831 females. During the decennium ending 1951, the population increased by 42 millions.

Density of population :—The average density of population of India is 312 per square mile. It is 3017 per square mile in Delhi, 1015 in Travancore-Cochin and 10 in Andaman Nicobar island.

Urban and rural population :—Out of 357 millions, 62 millions or 17.3% live in cities and towns while 295 millions or 82.7% live in villages. There is a slow but steady shift towards urbanization.

Town and Villages :—In India there are 3018 towns and 558,089 villages.

Houses :—There are 64.4 millions of occupied houses out of which 54.1 millions are in rural areas and 10.3 million in towns and cities.

Economic stratifications :—70% of the people depend on agriculture and 30% on non-agricultural professions.

Table I :—Showing the area per capita of the agricultural

and arable land in India and some other countries of the world.

	World	India	U.S.A-	Europe	U.S.S.R.
Population in crores	240	36.1	15.1	39.6	19.4
Land area in crores of acres	3251	81.3	190.5	121.8	590.4
Area per capita in cents	1354	225	1264	307	3046
All land					
Agriculture	351	97	741	153	448
Arable	126	97	302	92	287

Table II :—Showing population of India according to age groups.

	Age group	Percentage
Infant and young children	0— 4	13.5
Boys and Girls	5—14	24.8
Men and Women	15—24	17.4
	25—34	15.6
Middle aged men and women	35—44	11.9
	45—54	8.5
Elderly persons	55—64	5.1
	65—74	2.2
	75—	1.0

The above table shows that population of juveniles is very high and the population of people who live beyond middle age is very low.

Table III :—Showing comparison in the proportion of populations with those in some other countries of the world.

Countries	Percentage of total population			
	0—1 yrs.	1—4 yrs.	5—14 yrs.	55 & above
India	3.3	13.5	38.3	8.3
Europe	2.0	9.5	26.9	17.3
Germany	1.5	7.0	23.5	19.1
U. K.	1.5	8.6	22.5	21.1
France	1.6	7.2	21.5	21.4
U.S.A.	—	10.8	27.1	16.9
Africa	2.9	13.7	13.1	8.5
South and Central America	3.1	14.6	40.1	7.4

India has young population when compared with other Western countries which have aging population. So there is predominence of environmental problems and infectious diseases and tuberculosis. There is lack of capital and insufficiency of skilled workers.

In Western countries in aging population, there are opposite characteristics *i.e.*, importance of degenerative diseases and medical care. There is political and ideological conservatism.

Marital Status Pattern :—In India an outstanding feature of the marital pattern is the large number of child marriages which continue despite the Child Marriage Restraint Act. According to 1951 census, there are 2,833,000 married males 6,118,000 married females ; 66,000 widowers and 134,000 widows between the ages of 5 to 14.

Birth and Death rates and Infant mortality rates

Year.	Birth Rate	Death Rate	I.M.R.
1931	35.0	25.0	179
1941	32.1	21.9	158
1946	28.9	18.7	136
1951	24.9	14.4	124

Languages :—According to the constitution of India there are only 14 languages recognised in India but there are 845 languages, co-dialects including 63 non-Indian languages.

National Income and per capita Income :—National Income for India for 1951-52 was Rs. 9990 crores and per capita income was Rs. 274.5 in that year.

Working Force :—Out of 35.93 crores only 14.32 crores make up the working force, of which 10.37 crores or 72.4% of the total working force was agricultural and the rest are engaged in other professions like commerce, banking, manufacturing, hand trades etc.

Principal Crops :—India is an agricultural country and the principal crops grown are rice, wheat, jowar, bajra, gram, goundnut, cotton, fodder crops etc.

Pattern of Rural Economy :—There are on an average 5.21 persons in a rural house. Of these 28.1% are earners, 16.6% earning dependents, and 55.3% non-earning dependents.

Annual Consumer's Expenditure —Annual Consumers Expenditure is Rs. 220 per person in 1949-50.

Family Budget :—The National Income Committee has worked out the following family budget :—

Food.	66. 3%
Clothing.	9. 7%

Education.	0. 7%	Rs. 1.6
Health.	1.27%	Rs. 2.8
Fuel and light.	3.25%	
Ceremonial.	7.21%	
Other amenities.	Rest.	

Average annual expenditure on clothing in rural area is Rs. 21 per person. It is 31.4% in West India and 15.5% in East India.

Average annual expenditure on foot wear is Rs. 5.39 highest in North West India and Rs. 0.56 lowest in South India.

The Annual Expenditure on Medicines and Medical Services per Person : It is highest in East India being Rs. 3.97 and lowest in North India which is Rs. 1.42.

Holdings :—16.3% of all house-holds in rural areas have holdings of 10 acres, or above, 5.3% had 25 acres. Average holdings in India is only 5 acres, in Bombay 10.7, in Punjab 10, in Uttar Pradesh 6, in Bengal 4.5, in Madras 4 and in Hyderabad 12 acres.

Road and Traffic :—India's road system is insufficient for her needs. On an average, there are 6.7 miles of all-weather roads per hundred square miles of a country. The development of communication is one of the major items of India's Five Year Plans and Rs. 100 crores is allotted for the purpose.

Physiology of Society :—In case of an individual the physiological functions are digestion, circulation, respiration, assimilation, excretion, growth and reproduction.

In case of society similar phenomena are observed. They are dealt one by one as follows :—

(a) Digestion, which may be equivalent to food production and food distribution. It will depend further on available land resources, stage of industrialisation, balance between agriculture and industry, and on facilities of transport, marketing, stocking and distribution.

(b) In society the function of respiration will depend upon the type of living. It is poor in India. There is overcrowding in houses. They are ill-ventilated and are not giving proper protection against harmful effects of nature like sum, rain, storm, atmospheric pollution etc.

(c) Assimilation in society will mean the methods of consumption of food, the knowledge of food, and educational level for the utilisation of food.

(d) Excretion in society will depend upon excreta disposal, sewage disposal, disposal of house-hold refuse, disposal of kitchen waste, insect control, disposal of industrial waste etc.

(e) Growth of society in India will depend upon birth rate, factors playing on the average expectation of life, environmental like water supply, proper food supply etc., purchasing capacity of the society, internal security and protection against external dangers, form of Government, pattern of society which may be individualistic, fatalistic and socialistic etc.

(*f*) Reproduction of society :—A progressive and dynamic society can reproduce its kind, pattern, civilisation tradition. There are some of the principles which lead a nation or society to reproduce its kind by inflicting its nationality on other nations, by war or by foreign domination etc.

Some of the following tables will give an idea of our society .—

Table I

(A.C. Ukil Science and Health of India, Journal of Asiatic Society Vol. XX 1954, No. 193)

	Birth rates
Guatemala	48.7
Mexico	45.7
Federation of Malaya	42.0
Ceylon	40.3
Putorico	38.5
South West Africa	35.8
Israel	32.9
Chile	32.4
Peru	30.3
Yugoslavia	30.2
Japan	28.4
Canada	26.6
Union of South Africa	25.7
India	24.8
Portugal	24.2
Finland	24.0
U.S.A.	23.4
Australia	23.3
Lebanon	23.0
Netherland	22.7
Ireland	21.0

	20.4
France	19.9
Spain	19.6
Italy	18.6
Norway	18.1
Denmark	16.5
Belgium	16.4
Sweden	

Table II (India 1955 Page 10)

Population growth since 1891 in India :—

Census Year	Population in million
1891	236
1901	236
1911	250
1921	249
1931	276
1941	313
1951	356

During 30 years, since 1921, there has been an increase of 11 crores in population. The pattern of growth subsequent to 1921, shows that the growth of population was repeatedly checked by famine and pestilence. Cultivation kept pace with the growth of population before 1921. After 1921, however, it has been lagging far behind the population.

Table III (India 1955 Page 13) Urban and Rural population Percentage of total Population

Year	**Rural**	**Urban**
1921	88.7	11.2
1931	87.9	12.1
1941	86.1	13.9
1951	82.7	17.3

Table IV :—Expectation of life at birth.

Countries	Estimated for the Period	Expectation of life at birth Male	Female
India	1931—41	32.09	31.37
Mexico	1940	37.72	39.79
Canada	1947	65.18	69.05
Panama	1941—43	50.54	53.46
United States	1939—41	61.60	65.89
Chile	1940	37.9	39.8
Japan	1948	55.6	59.4
France	1946—49	61.9	67.4
Norway	1945—48	67.8	71.7
Sweden	1941—45	67.06	69.71
United Kingdom	1950	66.5	71.2

From the tables it can be seen that the average expectation of life in India is the lowest and unlike other countries, the expectation for females is less than that of males.

Public Health is a "purchasable commodity" and a modern public health programme will depend upon the capacity of the community to earn and pay. The following table of income and expenditure per capita will give some idea regarding the same.

Table V

Countries	Area in sq. miles	Population	Proportion density per sq. miles	Annual per capita income in rupees	Annual per-capita expenditure on the basis of revenue acccording to budget 1952—53
United Kindom	94,279	50,033,000	541.1	1069	1272
India	121,700	342,114,000	382.4	65	12.8
U.S.A.	—	—	—	1371	—

Table VI :—(A. C. Ukill Science and Health of India Journal of Asiatic Society 1954 Vol. XX). Revenue Expenditure under some items in U.K. and British India 1938-39.

Items	England & Scotland	British India
Defence	27.3%	34 0%
Police	40%	8.0%
Jails	0.1%	1.3%
Education	18.2%	8.4%
Medical and Public Health	22.7%	3.4%
Agriculture and Veterinary	1.5%	1.7%

Social Pathology:— Pathology is departure from the normal function or disfunction. In an individual this condition leads to subnormal or abnormal functioning of the physical and physiological functions.

In society and community, this condition leads similarly to subnormal or abnormal functioning of the society or community. It reduces the asset conditions and adds to liabilities.

Liability societies are either stagnant, unprogressive or minus societies. Asset societies are dynamic, progressive and plus societies.

Some conditions of society at large are as follows :—

1. *Comparative infant mortality rate of different countries for the year 1950.*

Chile	153.2	France	47.4
India	127.2	Canada	40.7
Phillippines	101.7	Switzerland	31.1
Portugal	94.1	Denmark	30.7
Ceylon	81.8	U S.A.	29.2
Spain	69.4	Australia	24.5
		Sweden	20.5

2. *Expectation of life at birth of different countries.*

	Male	Female	Year
India	32.09	31.37	1941
Canada	65.18	69.05	1947
U.S.A.	61.60	65.89	1939—41
U.K.	66.5	71.2	1950

Infant mortality conditions indicate the morbidity conditions in infants. Phenomena like infant mortality and expectation of life are the index of the fitness of environmental, social, institutional and cultural needs of a society.

3. *Comparative crude death rate of different countries :—*

Mexico	16.4	Japan	11.0
India	16.4	Switzerland	10.1
Chile	15.7	Sweden	9.8
Ceylon	12.6	Australia	9.6
France	12.6	Canada	9.0
U.K.	11.7	Norway	8.9

4. *Deaths at specific age groups, shown as percentage of total deaths at all ages. (Bhore Committee Vol. IV Page 2) :—*

	Under 1 year	1-5 years	10-5 years	Total under 10 years
British India 1935-39	24.3	18.7	5.5	48.5
England and Wales 1938	6.6	2.1	1.1	10.0

5. *Maternal mortality. (Bhore Committee Vol. IV page 2)*

About 200,000 woman die in India every year from causes associated with pregnancy and child bearing and some 4 millions suffer from varying degree of disability and discomfort as a result of the same causes.

6. *Maternal mortality in important countries* :—

India	U.K.	U.S.A.
20 (1945)	0.65 (1951)	0.9 (1949)

7. *Mortality figures from chief diseases in Indian Union.*

In rate per 100,000 population.

	1948	1950		1948	1950
Cholera	67	24	Fevers	114	1080*
Plague	9	2	Dysentery and Diarrhoea	69	84*
Small pox	17	11	Respi. Diseases	135	150*

*Figures for 1947.

Infant mortality rate, average expectation of life, the crude death rate and specific death rates, are the indices which show what is being done in the field of public health and social welfare in a country. From the study of above tables, it will be clear that the progressive and advanced countries have done much to accomplish in reducing the various mortality figures to the minimum. In progressive countries the expectation of life for females is also higher than for males. But in India the position is different. The reversed phenomena in women is due to causes associated with child bearing. Deaths among infants and children under 10 years of age show, that nearly half the total number of deaths are among children of 10 years of age and of this, half take place in 1st year of life.

8. *Population percentage by age groups.*

Age	India	U.S.A.	Germany	England	Sweden
0-15	39.8	25.1	21.7	21.8	20.8
5-50	50.6	54.6	55.5	53.6	55.0
50 & over	9.6	20.3	26.1	24.2	24.2

It will appear that the population of old people is much higher in the West, than in India but old people in the West are looked after by the State and are not a liability on an individual. Some social securities provided at State level, take care of them. India's population is a growing population and not aging population as we find in the case of West ; hence it has the important weakness of a growing population *i.e.*, lack of able bodied persons, lack of monetary return, scientific return, unstable governments etc.

Morbidity :—Mortality rates give some idea of health problems in a community but incidence of morbidity is a better and significant measure of health or ill health in a community and its relationship with economic status, with housing and

other environmental conditions, with overcrowding with the amount and kinds of medical care. Besides, there is a relationship between the morbidity and mortality rates.

In India 200,000 mothers die from causes associated with pregnancy and child birth whereas some 4 million mothers suffer from varying degrees of disability and discomfort. 2 million people die from Malaria every year and 100 million suffer from it. Similarly 500,000 die from tuberculosis and 2.5 million suffer from it.

But morbidity reporting is less efficient than mortality reporting. Many persons consult quacks, hakims and vaids, who do not keep a careful record of their clientele. Besides there are people who do not consult anybody and leave their sickness to the mercies of nature. So one has to glean up figures largely from surveys conducted in different countries of the world.

As regards the incidence of disease, malaria has constituted 61%, measles 10%, diarrhoea and dysentery 38%, other fevers 1%, typhoid fever, influenza and pneumonia 0.6% of total sickness, 4.4% population had hookworm infection and 3.7% round worm, Haemoglobin deficiency seems widely prevalent.

The morbidity rate is found the highest in infancy and quite high in lower age group.

It can be said with some certainty that India is the largest reservoir of infection for cholera, smallpox and plague. Their morbidity and mortality vary from year to year. In addition, there are endemic diseases like leprosy, filariasis, guineaworm and hookworm.

Preventable diseases impose a heavy burden in the loss of productive powers due to non-fatal but disabling illness as well as expenditure on medical and institutional care. In the United States of America tuberculosis costs 350 million dollars for medical care and other services. Sinton estimated that malaria in India involved an economic loss of 80 million pounds a year.

Both in urban and rural area the health conditions are very low. The causes of low level of health in India are :—

(a) Lack of provision for an environment conducive to healthful living, such a unhygienic houses, overcrowding, low standard of sanitation, primitive methods of collection, removal and disposal of refuse, excreta, unsafe water supplies, breeding of flies and mosquitoes etc.

(b) Lack of adequate nutrition. Food consumed is insufficient from qualitative and quantitative points of

view. In about 30% of families, it is deficient in calories and energy requirements. The diet is ill-balanced and deficient in vitamins, fats and proteins of high biological value.

(c) Lack of availability of health protection to all members of the community irrespective of their ability to pay for it. This will be clear from the following table of the strength of qualified health personnel in Indian Union in 1950 (A. C. Ukil's Journal) :—

	Total	Ratio of population.
Doctors.	59,317	1 : 6,019
Nurses	10,000	1 : 35,700
Health Visitors	600	1 : 595,000
Midwives	12,000	1 : 29,750
Pharmacysts	75	1 : 4,760,000
Dentists	3,407	1 : 104,784

Comparison in provision of services and qualified personnel Population served by.

	A bed	A doctor	A nurse	A midwife.
1. British India.	4,000	6,300	43,000	60,000
2. If 10 years programme Bhore committe is implemented.	971	2,000	500	4,000
3. United Kingdom.	141	1,000	300	628

The number of doctors employed in public health duties is 1,206 of whom 317 possess public health qualification. A little over 50% of 300 districts in India employ a medical officer of health, the rest are still unprovided for. The total number of sanitary inspectors employed is 3000. One health visitor for 400,000 population, a midwife for 60,000 cannot even touch the fringe of the problem of health. The shortage of personnel combined with insufficient number of hospitals, dispensaries, the quality of services rendered, the shortage of food, low literacy, lack of proper health education facilities, unhygienic surroundings, unfavourable conditions for work and rest, substandard and low standard of life, lack of legal implementation all contribute towards chronic asthenic morbidity in India.

India stands at the present moment from public health point of view behind United Kingdom by 100 years, U.S.A. by 75 years and Russia before the revolution.

Diagnosis—Diagnosis precedes treatment, is equally true both for clinical as well as Social Medicine, for there is a definite analogy between the study of diseases in the individual and

diseases or ill health in the group or community. The clinician is as much interested in the individual as the social medicine man in population group. The efficiency of diagnosis in clinical medicine is due to availability of standardised instruments like stethoscope, ophthalmoscope etc , but there is no such specified instrument in social medicine though there have been specialised methods of examining the group or community. These specified methods are included in the term 'survey'.

Types of survey :—There are two types of surveys *i.e.* general and special.

The general survey :—It is carried out by means of a schedule or schedules. with or without addenda worked out for these schedules. The general health survey reveals the influence of social, environmental, economic, educational and cultural factors and others, on the incidence of human disease and disability. Consequently it seeks and promotes measures other than those usually employed in the practice of remedial medicine against such forces which interfere with the full development and maintenance of man's mental and physical capacity.

Special survey :—It provides only limited information about the social factors and other factors involved in any specific disease or disability in relation to social conditions with family groups or community. Specific surveys have been extensively used for the study of disease and disability associated with occupation.

But logically a general survey precedes a special health survey, so that the effect of multiple factors on a specific problem is crystalised.

General health survey is generally conducted with the following objectives :—1. To obtain an integrated picture of the health conditions of the population and of some of the factors likely to influence the state of the community health.

2. To find out the main health problems of the community and to determine if possible their relative importance, thus helping in the formation of a progressive and balanced public health policy for better health protection.

3. To serve as the base for assessing the extent of progress that might be achieved as a result of specific health measures, by carrying out periodical survey of special types.

4. To collect material and to obtain a deeper appreciation of the health problems for purposes of teaching.

5. To evolve a complete scheme of general health survey for use in different parts of the country with such modifications as local conditions may warrant.

The General Scheme of investigation is as follows :—

1. To drop a theoretically sound sample of population.

2. To investigate all individuals included in the sample, with regard to their biological and social characteristics, anthroponutric measurements, state of health and disabilities at the time of investigation and during the past 12 months, supported by rapid clinical and laboratory examination, with special reference to nutritional assessment.

3. To reinforce the general investigation of individuals with special investigations for married women, infants, pre-school children, school children and pregnant women.

4. To investigate thoroughly the cases of such people for arriving at a diagnosis and general investigations of the circumstances in which the cases of notifiable diseases arise.

5. To classify families with regard to socio-economic and biological characteristics.

6. To assess the sanitary conditions of houses.

7. To visit villages for purposes of study of environmental conditions and special organisation with particular reference to schools, hospitals, other corporate activities.

8. To take into account the work of voluntary organisations working in the area, their constitution, official status, their range of activities, their attitude towards official agencies and their achievements in their respective fields.

SOCIAL SECURITY

The progress and welfare of a society depends upon 4 important factors, which are as follows :

1. Education.
2. Health.
3. Social Security.
4. Production.

These four factors not only support the society, but keep it free from disease, ignorance and poverty. Education if imparted properly, prepares a person to develop the spirit to live and assert his right as a good citizen. Health increases the working capacity of the individual and contributes towards adding more assets to a society. A sick person is a liability. For the present in most parts of the world there is a provision more for sickness than health.

The world social security is often confused with social insurance. The former is a positive aspect of security whereas social insurance is used in a negative sense. It is an insurance

against mishaps in life like illness, death, disablement etc. Social insurance is a part of social security. Social security in its modern connotations covers all the contingencies that a human being, may come across from the time of birth upto the time of funeral or cremation. A few of the contingencies covered by social security plan are mentioned below :—

1. Medical care in times of illness.
2. Medical care and cash allowance during absence of work on account of employment injury.
3. Cash allowance during the time of sickness.
4. Prenatal and postnatal medical benefits in times of maternity together with cash allowance during a period before and after child-birth.
5. Pension during the period of invalidity.
6. Old age pension after attainment of specified age.
7. Dependence benefit, cash allowance to wife or children, in case of death of earning member.
8. Payment of funeral or cremation expenses.
9. Cash allowance during the period of unemployment.
10. Childrens' allowance, in payment of cash allowance to each child in a family, so that the children can be brought up.

The more progressive a society is, the broader are the means of social security. At this time Sweden is the most advanced country in this respect. In it, social security schemes and related services include national pension scheme, the previous childrens' supplements, childrens' special allowances, industrial injuries benefits, subsidies to the voluntary sickness benefits, and unemployment insurance, public assistance, child welfare, maternity and confinement benefits, health schemes for mothers and children, other health and medical services, housing credits and subsidies and marriage loans.

Health Insurance in India :—It is an assurance or guarantee given by the State that is by the Government of the country that the health of the people would be protected by the state from ill health and disease,

It is necessary, because as per Constitution of India, the Government of India has been declared to be a welfare state and therefore it behoves, the state to take every step to render assistance to the people of the state to see that their health is not impaired. Secondly a great majority of people in India are illiterate ; they are not able to read and write, so as to understand and reap the advantages of scientific achievements

in health and hygiene. On account of ignorance the power of earning of the majority of the people is so poor that they cannot afford to get adequate medical aid, even when it is absolutely necessary. As a consequence of this, great many people suffer from diseases and die prematurely. With a view to checking national degeneration, the Government of the country has formulated and brought into effect a scheme called Health Insurance.

Employees State Insurance Scheme :—National Insurance against sickness and injury at work provides a unified and comprehensive scheme and is designed eventually to cover every one. This is the first step towards Social Security. In 1948 India made a beginning, by introducing Employees' State Insurance Act to provide benefits to employees in case of sickness, maternity and employment injury and disablement. This act is the first of its kind in the whole of South East Asia. It was amended in 1951 to meet the objections of employees in Delhi and Kanpur on the grounds of increased cost of production.

Scope :—The act at present applies to all perennial factories using power and employing 20 or more persons. It covers labourers employed directly and indirectly and also clerical staff. It does not apply to persons whose total remuneration exceeds Rs. 400/- a month. There is a provision in the Act to extend the benefits to other classes of labour, such as agricultural, commercial etc.

Administration :—The scheme is administered by Employees' State Insurance Corporation consisting of the following :—

(*a*) Labour Minister Government of India, Chairman.

(*b*) Health Minister Government of India, Vice-Chaiman.

(*c*) Not more than five persons nominated by Central Government of whom at least 3 shall be officials of Central Government.

(*d*) One person representing each of the part A and part B States in which the act is in force, to be nominated by the State Governments concerned.

(*e*) One person nominated by Central Government to represent part C States.

(*f*) Five persons nominated by Central Government representing employees.

(*g*) Two persons nominated by Central Government representing the medical profession.

(*h*) Two elected by the Parliament.

Two of these 13 members form a standing committee for general administration. Twenty eight members constitute a medical benefit council to advise the corporation on medical benefits.

The executive head of the corporation is the Director General, who functions through a net work of regional and local officers. There are Regional Advisory Boards, which includes representatives of employers, employees and State Governments.

Source of income :—The income of the Employees' State Insurance comes from three sources :—1. Contributions from employees at the rate specified by the act and the rules framed at various times. It varies from —13 nP to Rs. 1.25 nP per week and works out to be from 2 to 2.5% of thier wages. Employees with average daily wage of less than a rupee are not required to pay anything but their employers are not exempted. The contribution is payable by employers only in implemented areas.

2. Unlike contribution from employees which is payable only in implemented area, the employers' contribution is payable throughout the country, irrespective of the fact whether the concern is covered or not. In the original act, this contribution was on a graded scale like that of employees' contribution, but roughly double of the latter. In the amended act of 1951, this is replaced by what is called "Special contribution." This is applicable only until such time, as the act is implemented in the whole country. At present it amounts to ¾% of the total wage bill, in unimplemented areas and 1¼% in implemented areas. The difference of ½% is due to the fact that the responsibility of the employers as regards Workmen' Compensation Act is taken over by the corporation in implemented areas. This contribution is liable to be increased as the scheme is implemented in more areas subject to a maximum of 5%.

3. The Central Government has contributed 2/3 of the cost of administration of the scheme for the first 5 years. The State Governments' contribution, which was 1/3rd upto June, 1954, has been revised to ¼ of the cost of medical benefits provided to the insured persons in their respective areas with effect from July 1954. There is a provision for the corporation to receive loans from the Central Government or any individual etc. The latest available figures show that over Rs. 2 crores have been received as contribution, over Rs. 174 lakhs being from employers and Rs. 39 lakhs from employees.

A Benefits :—The following types of benefits are envisaged for the employees insured in factories :—*1. Sickness Benefit* :— This is a cash allowance payable to workers during absence from work caused by sickness and certified by the corporation doctors.

The maximum benefit payable is for 56 days in a year. The question of extending this period for sufferers from tuberculosis and other long-term diseases is under consideration. The rate of benefit is roughly half the daily wages. No benefit is payable for the first two days of a spell of sickness.

2. *Maternity Benefit*—This is also a cash allowance-payable to an insured woman employee for a period of 12 weeks of which not more than 6 weeks can proceed the expected date of confinement. It is also roughly half the salary.

3. *Disablement Benefit* :—Disablement may be temporary or permanent, partial ot total due to employment injury. In case of temporary disablement exceeding 7 days the cash benefit will be paid from the first day. The amount of benefit for permanent disablement is decided on the recommendations of a medical board.

4. *Dependent Benefit* :—If an employee dies as a result of employment injury, the dependent's wife and children and in certian cases aged parents will also get a certian benefit for life of certain period, in form of pension.

B. Medical Benefit :—This provides for their complete medical treatment with reasonable skill of medicine, surgery and obstetrics. This includes :— (a) Outdoor treatment at a dispensary or clinic of a private doctor.

(b) Free hospitalisation.

(c) Specialistic care with all free investigations.

(d) Free supply of all necessary drugs, injections and dressings.

For the workers who reside far away from these dispensaries the following additional methods have been introduced :—1. Mobile dispensaries visiting scattered population in villages.

2. Full time doctors attending at different times at separate centres, or part-time doctor for one or more centres.

3. Providing treatment at an existing hospital, dispensary or any other institution maintained by the State or at the clinics of private medical practitioners.

Administration :—The administration of cash benefits is carried out by the Employees State Insurance Corporation, through its regional and local offices. The country is divided into 5 regions-Bombay, Calcutta, Delhi, Kanpur and Madras. The administration of medical benefit rests with the State Medical Department who are paid 3/4 of the expenditure by the corporation.

Progress of the Scheme :—The scheme was first introduced in Kanpur in February. 1952. Now it has been introduced in Punjab Bombay, Madhya Bharat, Madhya Pradesh, Hyderabad, Madras and Calcutta. Full-time medical officers (State employed, give outdoor treatment in Uttar Pradesh, Hyderabad, Saurashtra, Delhi, Madhya Pradesh, while part-time insurance medical practioners (panel system) do so in other areas—Punjab, Bombay and Calcutta). In same areas *e.g.* Madhya Bharat, Coimbatore etc. bill system is running side by side. The Government has opened dispensaries for workers, in selected areas and a certain number of workers are assigned to a particular dispensary. At each dispensary a worker gets outdoor treatment at a general practitioner's level. He is provided with necessary dressings, injections and medicines. For investigation in hospital, the worker is referred to some selected state hospitals where he is investigated and referred back to the dispensary for continuation of treatment or is detained in hospital for special attention.

In Bombay and other places, where panel system is working, a certain number of doctors—insurance medical practitioners, are employed each having a number of workers on his list ; the number depending upon his popularity subject to 1,000 workers on his panel. This worker has a free choice of a doctor in this system. A panel doctor gets Rs. 6.50 np. in Bombay and Calcutta for insured worker per year and Rs. 6/- elsewhere in India. This includes attention in clinic, home visits if required, dressings, routine mixtures, powders, pillls and common injections, but costly medicines can be had from certain approved chemists on his recommendation. The worker gets specialist skill and investigations at diagnostic centres opened by State Governments at the State hospitals on recommendations from the panel doctor. Here investigations like examination of blood, sputum, urine, stools, X-rays are carried out. If a patient is to be referred to a hospital, the State Government has made arrangement with certain state or privately run hospital for their admission. The usual preventive inoculations are to be given by the insurance medical officer or panel doctor. Thus there are two systems on trial *i.e.* State Service System and Panel System. In panel system, the worker can choose his doctor and can change him after a year or earlier if he changes his residence. It is a competitive scheme and hence the doctor is always more alert and has to think of the social side of the patient. The worker, if satisfied with the doctor, can take his family to him.

In the service system, the doctor will attend only the worker. For his family, the worker has to approach another doctor. A panel doctor will get private practice from the worker's family and thus physician-patient or physician-family relationship

could be preserved. But in service system there is advantage of controlling geographical distribution, better overall control by the State, though the doctors are apt to get mechanised, lose their independent and prompt action and take little interest in medical research. The worker does not have a free choice and may have to go to more than one doctor in course of a single illness. A state service doctor is liable to get a transfer and the patient-doctor relationship cannot subsist. On the whole, the advantages of the panel system are more than the State service system.

REHABILITATION-Definition :—It may be defined as any service necessary to render a disabled person fit to engage in a remunerative occupation. In practice it is a service of vocational adjustment through a programme of vocational counselling, training and placement with supplementary services. It is a service for creating and recreating earning capacity for all types of physically handicapped persons through vocational adjustment. It not only helps production but it also makes the worker happier in that he is not dependent on others, for his living and has the satisfaction of remaining a useful member of society. In rehabilitation the cooperation of the individual at all stages is essential.

Evolution :—The ancient and the medical attitude towards the handicapped was one of cruelty, neglect, contempt and later pity which was satisfied by alms-giving. In too many minds, even today, the word handicapped, disabled or crippled excites sympathy and persons who are the victims of these defects, either congenital or acquired are looked down upon as sub-standard people, separate and distinct from normal population. Modern medical, surgical science and modern aid to vacational adjustment have changed this picture. Physical restoration or improvement is now the rule rather than the exception. Vocational preparations for other jobs is accepted as a feasible and successful method of making the disabled efficient, self-supporting and self-respecting citizens.

Principles :– The underlined principles of vocationol rehaabilitation are based on :—

(*a*) The democratic concept of the way of living demands, equity of opportunity for all citizens including the physically handicapped.

(*b*) The society expects the support of each citizen in proportion to his capacity. Vocational rehabilitation offers to the handicapped person and opportunity for employment and at the same time, makes possible his due contribution to the society.

(c) Experience has shown that most disabled persons can work efficiently, if prepared for jobs compatible with their physical conditions. A man with a big ambition can do anything at bench that a normal man of equal skill can do. A man with an arm amputation may still be a competent sales-man, draftsman, artist or a lawyer. A deaf man is handicapped only in communication and not unskilled with the use of his hands. Thus a disabled person has far more vocational assets than are lost through his impairment.

(d) The disabled person has a right to work ; his needs do not differ from the needs of others. It is a matter of social justice to prepare him for suitable job and thus place him on economic parity with his fellows.

(e) Society benefits by employment of the disabled. The burden on public relief is lessened.

(f) A nation's foremost asset is its citizenship. The development of each individual for useful productiveness is the soundest policy.

(g) Vocational rehabilitation is economically sound.

How to organise rehabilitation service :—

1. Disabled persons are located through an organised case finding programme and offered rehabilitation service, if unemployed or under-employed.
2. An expert diagnosis is made of their employment needs and of their physical, mental and vocational resources.
3. Corrective surgery or therapeutic treatment may be provided or secured, if necessary for employment.
4. Prosthetic devices (limbs, hearing aid etc.) may be provided or secured, if necessary for employment.
5. Expert counselling or guidance assists them to decide upon a suitable employment objective.
6. A plan is prepared outlining the steps or services needed to enable the disabled person to secure suitable employment.
7. Training carefully planned and supervised, is provided, to those, who need such preparation for employments.
8. Maintenance during training may be provided in case of need.
9. Other necessary services, incident to the solution of personal or family problems are provided or secured.

10. The culminating factor and an essential step in every case is entry into suitable remunerative employment. Such placement is followed up to determine its lasting success or to provide any needed adjustment.

Rehabilitation Programme in Various Countries

1. UNITED STATES OF AMERICA :— Goodwill Industries. Boston :—It is an industrial organisation and not a charitable institution. It gives training to the disabled and then employs them in various branches of their industry. It is run on non-profit, self-sufficient lines. The Goodwill Industries collect discarded materials from between 1 to 2 million American homes, provide employment to 16,000 disabled persons and give them wages of nearly 8 million dollars a year.

2. NORWAY:—League for Cripples runs four homes where cripples receive vocational training.

3. ENGLAND :—Disabled Persons Co-operation Ltd. A private enterprise to organise factories, where disabled persons may work under sheltered conditions, has been established.

Rehabilitation as a Socio Economic Field :—Its vast economic potentialities are just beginning to be appreciated and an ideal field for medical social workers. Any initial investment for retaining, adjusting and preparing a disabled person will give a very good economic return both to the individual and the community ; over and above the removal of society stigma and social liability.

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CHAPTER XXI

VITAL STATISTICS

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There are three known methods of gaining scientific knowledge intuitive, experimental and statistical. The power of correct intuition is very rare and is found only in very few gifted individuals to any marked extent. The experimental method requires strictly controlled conditions, which are very difficult, if not impossible to achieve in human beings. The only way open to a medical man to increase his knowledge is field studies influenced by multiplicity of causes, and to analyse the findings so as to determine the exact influence of each cause or condition. This is the statistical method. The science of Statistics has been defined as a study of the methods applied in collecting, analysing and interpreting quantitative data in a department of enquiry. Statistics are figures arranged in such a manner as to bring out any significance which they may possess.

VITAL STATISTICS

Vital statistics are statistics relating to the life history of communities or nations. They include the events of origin, continuation and termination of the lives of people. Raymond Pearl has defined it as the special branch of Biometry which concerns itself with the data and laws of human mortality, natality, morbidity and demography.

In recent years, the term "Vital Statistics" has been used to denote facts, systematically collected and compiled in numerical form, relating to or derived from records of vital events, namely live births, deaths, foetal deaths, marriages, divorces and the like.

IMPORTANCE

Vital statistical data truly constitute the bookkeeping records of any nation. When somebody comes to you for a medical check up, you take his temperature, count his pulse beats, measure his blood pressure, count the proportion of various blood cells and look for the presence of specific diseases. But what about a community ? It also needs a periodic check up. Is it a healthy community or has it some diseases ? What diseases ? The periodic check up of community health depends mostly upon recording, continuously and completely, all vital events in each individual household. And there are vital statistics. They give us complete information about the life

history of a community which can be obtained in no other way. They furnish the means of comparing the life history of a group or nation with that of others and of the present with the past. The vital statistics present a picture of the state of adjustment of the community to environments. They help us to plan the policies and programmes of public health and to assess the results of such programmes.

SOURCES

There are three sources of vital statistics namely census. registration and survey. Census is an actual count of the population at a particular moment. Registration is recording an event as and when it happens. Survey is a specially carried out collection of all data and its detailed analysis.

CENSUS

Census is a count of the whole population at a particular moment, theoretically instantaneous. It indicates a cross-section of the population at that particular moment. In practice, it is taken during one particular day.

The first census was taken in Sweden in 1749. In India, the first census was taken between 1867 and 1872 and was repeated in 1881. Subsequently it is being done at an interval of ten years. The last census was taken on 1st March, 1961.

Despite precautions, many errors occur in the census. Some of the people are missed, others are counted twice. Errors in the recorded age are most frequently met with. In India, a good majority of people do not know their exact age, others do not give their exact ages because of indifference.

ESTIMATED POPULATION FOR ANY INTERCENSAL YEAR.

It is estimated by the following methods :—

1. Natural increase method :

Estimated population=census

Population plus (births—deaths) plus (Immigrants—emigrants).

2. Arithmetical progression method : It is assumed that the population increases in arithmetical progression, that is by the same number, every year.

Example : Let the population of a town is 1951 be= 142,427.

Let its population in 1941 be=131,237.

Increase in ten years=142427—131,237=11,190.

Annual increase in population=11,190/10=1,119.

Population in 1960 i.e. 9 years after the last census=142,427 plus 9x1,119=152,498.

3. Geometrical progression method: It is assumed that the population increases in geometrical progression i.e., the ratio of population of any year to that of the previous year is the same.

Example 2: Let the population of a town in 1951 be= 142,427.

Let its populations in 1941 be=131,237.
If the annual rate of growth be r, 12 log r=log 142,427—log 131,237=5.1535924=5.1180563=0.0355361 log r=0,00,035,536.

Log of the estimated population in 1960 i.e. 9 years after the 1st census=5.1535924 plus 9 (0.0035536)=5.1855748.

Population in 1960=153,312.

4. The inhabited house method.: This method is of particular use in towns, where the house-tax is in force. The total number of houses in the town is obtained from the tax registers. This number is multiplied by the average number of inhabitants per house as ascertained in the previous census. An addition of one person is made for every uninhabited house. This accounts for beggars, sadhus and other pavement dwellers.

REGISTRATION

It is the recording of an event as and when it happens. In a number of Western countries, registration of all vital events i.e. births, deaths, many diseases, and even marriages and divorces is compulsory. In our country the vital registration is done for births and deaths only. This is also very unsatisfactory especially in the rural areas. The system of registration of births and deaths was first introduced in India in 1863. Generally speaking, a registrar or sub-registrar is appointed for keeping the records of births and deaths in a particular locality. In the rural areas he is usually the police officer incharge of the Thana or Police Station. In towns, the Health Officer or Sanitary Inspector is usually the registrar. The period within which births and deaths should be brought to the notice of this officer differs at different places, varying from twenty-four hours to two weeks.

In registering births the following particulars are usually noted :—

1. Date of birth,
2. Name (if any) of the child,
3. Sex,
4. Name of father and grand father,
5. Occupation,
6. Address,
7. Name of reporter,
8. Date of reporting,
9. Name of dai or attendant at the delivery, if any,
10. Name of mother,
11. Age of mother,
12. Parity of mother.

The following particulars are usually noted in registering deaths :—

1. Date of death,
2. Name of the deceased,
3. Name of the father or husband (in case of married woman).
4. Sex,
5. Occupation,
6. Age of the deceased,
7. Address,
8. Cause of death,
9. Duration of last illness,
10. Name of reporter,
11. Date of reporting.

In the rural areas of most of the States of India, the chaukidar is the primary agency responsible for the recording of the births and deaths. His illiteracy and ignorance besides his per-occupation with other duties (which he considers more important) are well-known, He is expected to record all births and deaths occurring in his beat (sometimes three or four

villages) in his books and to report them fortnightly to the nearest police station. What actually happens is that he catches hold of any conveniently available semi-literate person just before going to the police station and gets entered in his registers particulars of all births and deaths, he can remember at the moment. He does not worry about inaccuracies. He just wants some entries to be made. The primary reports of vital events are recorded by the registrar, as above described, who passses on the data to the District Health Officer or the Civil Surgeon through the Superintendent of Police or the District Magistrate. The district figures are then passed on to the Director of Health Services of the State, who periodically publishes them. The all-India figures are published, Statewise, by the Registrar-General.

The main defects of the vital records of India as maintained by this method, are omissions, lack of uniformity in compilation, inaccuracies with respect to the cause of death.

MEDICAL CERTIFICATION OF CAUSE OF DEATH.

The correct recording of Vital Statistics is of the greatest importance if our country is to prosper and progress. As is wellknown no enterprise, business, agriculture, industry or any such undertaking can succeed unless we keep full accounts of its income and expenditure. When we are dealing with the much more important enterprise of human life to keep an account of when and where people come, and how, when, and why they go away is of supreme importance. Of greatest importance in this connection is the cause of death, so that steps may be taken to prevent unnecessary loss.

With this object in mind it is desirable that all deaths especially those occurring in all the towns and in all villages where dispensaries are situated should be recorded on the International Form of Medical Certification of Cause of Death.

This form was first devised by the Sixth Decennial International Revision Conference, meeting in Paris in 1948, It calls for statements on the morbid condition, directly leading to it, the underlying cause of death, and contributory conditions. In order to obtain correct factual data it is essential that you should realise what is required of you in using this form.

This form (Figure 1) places upon the Medical Officer the responsibility of indicating the exact course of events leading to death.

FIGURE 1.

MEDICAL CERTIFICATE OF CAUSE OF DEATH

For use by Statistical Office

NAME OF DECEASED (Type or print) | DATE OF DEATH

SEX	MARITAL STATUS (S, M, W or D)	DATE OF BIRTH	AGE (In years last birthday)	If under 1 year		If under 24 hours	
				Months	Days	Hours	Minutes

CAUSE OF DEATH		Interval between onset and death	
I **Immediate cause** State the disease, injury or complication which caused death, not the mode of dying such as heart failure, asthenia, etc.	(a) ______ due to (or as a consequence of)		Det. List code
Antecedent causes Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last	(b) ______ due to (or as a consequence of) (c) ______		N Code
II **Other significant conditions** contributing to the death, but not related to the disease or condition causing it	______		II

Accident, Suicide, Homicide (Specify) | How did injury occur?

IF DECEASED WAS A FEMALE:
Was the death associated with pregnancy? .... (yes or no) Was there a delivery? .... (yes or no)

NAME (Rubber stamp) OF INSTITUTION | SERIAL NUMBER in institution | DATE OF SIGNATURE

SIGNATURE of medical attendant

The following directions should be kept in mind while filling in this certificate :—

(i) **Name of deceased.** To be given in full. Do not use initials. If deceased is an infant, not yet named at time of death, write "Son of" (S/o) or "Daughter of" (D/o), followed by names of mother and father.

(ii) **Date of birth.** Please try to ascertain this in the largest possible number of deaths. It is of great importance from both the legal and statistical point of view.

(iii) **Age.** This should be stated whether or not the date of birth has been given. If deceased is more than one year old: give age in years last birthday (completed number of years). If under 1 year: give age in months and days. If under 24 hours : give age in hours and minutes.

(iv) **Cause of death.** This part of the form should always be completed by the attending physician personally.

The certificate of death is divided into two parts, I and II. Part I is again divided into three parts, lines (a), (b), and (c). If a single morbid condition completely explains the death, then this will be written on line (a) of Part I, and nothing more need be written in the rest of Part I or in Part II. For example, small-pox, lobar pneumonia, cardiac beriberi, are sufficient causes of death and usually nothing more is needed.

Often, however, a number of morbid conditions will have been present at death, and the doctor must then complete the certificate in the proper manner so that the correct underlying cause will be tabulated. First, enter in Part I (a) the immediate causes of death. This does not mean the mode of dying, e.g., heart failure, respiratory failure, etc. These terms should not appear on the certificate at all since they are modes of dying and not causes of death. Next consider whether the immediate cause is a complication or delayed result of some other cause. If so, enter the antecedent cause in Part I, line (b). Sometimes there will be three stages in the course of events leading to death. If so, line (c) will be completed. The underlying cause to be tabulated is always written last in Part I.

Morbid conditions or injuries may be present which were not directly related to the train of events causing death but which contributed in some way to the fatal outcome. Sometimes the doctor finds it difficult to decide, especially for infant deaths, which of several independent conditions was the primary cause of death; but only one cause can be tabulated, so the doctor must decide. If the other diseases are not effects of the underlying cause, they are entered in Part II.

(v) **Do not write two or more conditions on a single line.** Please write the names of the diseases (in full) in the certificates as legibly as possible to avoid the risk of their being misread.

(vi) **Onset.** Complete the column for interval between onset and death whenever possible, even if very approximately, e.g., "from birth", "several years."

(vii) **Accidental or violent death.** Both the external cause and the nature of the injury are needed and should be stated. The doctor or hospital should always be able to describe the injury, stating the part of the body injured, and should give the external cause in full when this is known. Example: I (a) Hypostatic pneumonia; (b) Fracture of neck of femur; (c) Fall from ladder at home.

(viii) **Maternal deaths.** Be sure to answer the questions on pregnancy and delivery. This information is needed for all women of child-bearing age, even though the pregnancy may have had nothing to do with the death.

(ix) **Old age or senility.** Old age (or senility) should not be given as a cause of death if a more specific cause is known. If old age was a contributory factor, it should be entered in Part II Example: I (a) Chronic bronchitis; II Old age.

(x) **Completeness of information.** A complete case history is not wanted, but, if the information is available, enough details should be given to enable the underlying cause to be properly classified.

EXAMPLE: *Anaemia*—Give type of anaemia, if known. *Neoplasms*—Indicate whether benign or malignant, and site, with site of primary neoplasm, whenever possible. *Heart disease*—Describe the condition specifically; if congestive heart failure, chronic cor pulmonale, etc., are mentioned, give the antecedent condition. *Operation*—*Tetanus*—Describe the antecedent injury, if known. *Operation*—State the condition for which the operation was performed. *Dysentery*—Specify whether bacillary, amoebic, etc., if known. *Complications of pregnancy or delivery*—Describe the complication specifically. *Tuberculosis*—Give organs affected.

Symptomatic statements. Convulsions, diarrhoea, fever, ascites, jaundice, debility, etc., are symptoms which may be due to any one of a number of different conditions. Sometimes nothing more is known, but whenever possible, give the disease which caused the symptom.

Survey :—A survey or investigation is the most scientific method of collecting data. We first define the problem to be investigated, pick out all cases relevant to it, and investigate them in detail. The kind of data to be collected and the manner in which the collection is made depend upon the pro-

blem. A control group, is also necessary. Its purpose is to permit the isolation of the factor responsible for a particular result. It is necessary therefore, that this control group be similar to the group under study in all respects except the object of study.

Rates and Ratios :—Ratio is a relationship between two members; Rate is a particular type of ratio. It is a relationship between the number of times a specific kind of event occurs and the number of exposures to the risk of its occurrence.

Birth Rates :—Crude birth rate : It is number of live births in a specified time, in a specified population, usually in a year per thousand population. Crude annual birth rate

$$= \frac{\text{No. of live births in a year} \times 1000}{\text{Mid-year Population}}$$

Annual crude birth rate based on weekly and monthly births is calculated as follows :

Crude annual birth rate

$$= \frac{\text{No. of births in a week} \times 52 \times 1000}{\text{Mid-year population.}}$$

$$= \frac{\text{No. of births in a month} \times 12 \times 1000}{\text{Mid-year Population.}}$$

Age-Limited Birth Rate :—Althogh the crude birth rates will show the general trend over time and the approximate levels of natality among different geographic areas, a rate based on the population which more closely corresponds to the group "exposed to risk" is more meaningful for certain purposes, especially for international or inter-area comparisons. The numerator of the refined rate would remain the same as the crude rate, but the denominator would be limited to the age-sex group of the populatien able to contribute to the birth rate, The formula for such a rate, known as the "age limited live-births rate" is given below in terms of the female population :—

Annual age limited live-birth rate (also known as a "fertility" rate)

$$= \frac{\text{Number of live births which occurred among the population of a given geographic area during a given year.}}{\text{Mid-year female population of ages 10 to 49 in the given geographic area during the same year.}} \times 1{,}000$$

Foetal Deaths :—The figures of foetal deaths should neither be included in the births nor deaths in the official records. They should be compiled separately and compared to live births.

Foetal Death is death prior to the complete expulsion or extraction from its mother of a product of conception, irrespective

of the duration of pregnancy; the death is indicated by the fact that after such separation the foetus does not breathe or show any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles.

Stillbirth :—It is defined as synonymous with late foetal death, that is, of twenty-eight completed weeks of gestation or over.

Crude Death Rate :—It is calculated in the same way as crude birth rate that is number of deaths in a specified population in a specified time.

Crude death rate

$$= \frac{\text{No. of total deaths in a year} \times 1000}{\text{Mid-year Population.}}$$

Annual crude death rate based on weekly or monthly deaths is calculated as follows :—

Crude annual death rate

$$= \frac{\text{No. of deaths in a week} \times 52 \times 1000}{\text{Mid-year Population.}}$$

$$= \frac{\text{No. of deaths in a month} \times 12 \times 1000}{\text{Mid-year Population.}}$$

Specific Death Rate :—Mortality due to a specific cause or amongst a selected group of persons specified according to age, sex, occupation etc., is called the specific death rate.

Specific dath rate

$$\frac{\text{No. of deaths in a specified classs of popuation in one years} \times 1000}{\text{No. of persons exposed to the risk of dying in a specified class of population.}}$$

Age specific death rate :—

$$\frac{\text{No. of persons dying in one year in the age group e.g. of 10-15 years} \times 1000}{\text{The total No. of persons in that age group (e.g. 10-15 years).}}$$

Age Specific death rates are comparatively higher at the extremes of life. Sex specific death rate is usually higher for males in all developed countries but in under-developed countries like India, it is higher for females in the reproductive age group. The healthiest period of life in India is between the ages of 10 and 25. Specified death rates may also be calculated for different occupations. In order to calculate it, the number of deaths occurring among those engaged in a particular occupation and the total number of persons so engaged must be known.

Occupation death rate :—

$$= \frac{\text{Number of deaths occurring in a year among those engaged in a particular trade or occupation} \times 1000}{\text{Total No of persons so engaged.}}$$

Generally speaking mortality is higher among industrial workers, particularly those engaged in jute, textile, paper and iron mills, mines and chemical factories.

Standardised Death Rate :—In comparing the mortality conditions of a number of places, or mortality conditions in the same place at different periods of time, the respective crude death-rates cannot be used, because such rates are often affected considerably by the age and sex constitution of the population concerned. The fact that the crude death rate of one place is higher than of another place is in itself no evidence of worse mortality conditions in the former place. Any population containing many persons round about the ages of 10 to 25 when the death-rate is at its minimum, must have a lower total (crude) death-rate than that of a population containing many infants or old people, at which points of life the death-rate is relatively high, even though the age specific death-rates for nearly all ages in the former population may be higher than those in the latter. Again comparison of death rates may also be affected by the sex proportions of the populations considered, for at most ages and from most causes females generally suffer a lower mortality rate than males, except during the child bearing age.

It therefore follows that crude death-rates should be corrected to allow for differences in the age and sex distribution of the population. This may be done by the use of what are called standardised rates, that is by theoretically equating the age and sex compositions of the different populations.

Infant Mortality :—It denotes the deaths of infants (below one year of life) in a community. It is the best known measure of the effectiveness of public health measures in any community. Infant Mortality Rate

$$= \frac{\text{Number of deaths during the year of children under one year} \times 1000}{\text{No. of live births during the year}}$$

Other things being equal infant mortality rate is higher among male than female children as male children are more delicate and comparatively more difficult to rear than the female ones.

Neonatal Mortality :—It denotes the mortality of infants within four weeks of their birth. Neonatal mortality rate

$$= \frac{\text{No. of deaths during the year of infants under 28 days} \times 1000}{\text{No. of live births.}}$$

Maternal Mortality.:—It denotes the mortality of mothers who die during pregnancy, child birth or as a result thereof.

Maternal mortality rate

$$= \frac{\text{No. of maternal deaths in a year in pregnancy, childbirth or as a result thereof} \times 1000}{\text{No. of total births in the year.}}$$

Perinatal Mortality :—Because there is reasion to believe that some deaths during the first week of life are inadvertently or deliberately registered and counted as late foetal deaths, and because the problems underlying late foetal mortality are frequently related to those causing mortality during the first few weeks of life, some investigators have suggested combining data to obtain one rate which could measure the risk of dying during the period near parturition, also known as the "perinatal" period.

Morbidity Statistics :—The registration of diseases is incomplete, even in highly developed countries. In India and other underdeveloped countries, where even the registration of births nnd deaths is inadequate and incomplete, almost no statistics of diseases are available. They may, however, be obtained by a special survey, that is recording all the cases of a particular disease occurring in a particular area and a particular period of time. The findings may, then be described in terms of the incidence of prevalence of the disease in that particular locality.

$$\text{Incidence Rate} = \frac{\text{Frequency of illnesses commencing during a year from a particular cause} \times 1000}{\text{Total mid-year population.}}$$

$$\text{Point Pravalence Rate} = \frac{\text{No. of cases suffering from a particular disease at a particular instance of time} \times 1000}{\text{Population at that particular time.}}$$

Case Fatality Rate

$$= \frac{\text{No. of deaths among cases of the disease for which rate is to be calculated} \times 1000}{\text{No. of cases of the disease or persons suffering from that disease.}}$$

Mean Duration of Life or Expectation of Life at Birth.

It is the average number of years which persons of a given locality, group or community live, assuming that they die according to a given table of probabilities of life, i.e., according to a life table.

Life Table :—It represents a generation of individuals passing through life to extinction. The table furnishes the mean duration of life or the expectation of life at birth, and also the average length of time a person of any age may be expected to live.

STATISTICAL EVIDENCE

Statistical evidence of the health of a community is furnished by the following :—

1. Crude death rate.
2. Infant mortality rate.
3. Maternal Mortality Rate.
4. Expectation of life at birth.
5. Perinatal mortality rate.

Vital Statistics of India and Punjab.

The population of India (1961 census) is 436,424,429.

The population of reorganised Punjab (1961 census) is 202,98,151.

The density of population in India (1961) is 384 per sq. mile.

The birth rate of India (1956) is 30.78 per 1000.

The birth rate of Punjab (1958) is 40.4 per 1000.

The death rate of India (1956) is 13.41 per 1000.

The death rate of Punjab (1958) is 15.0 per 1000.

The infant mortality rate of India (1956) is 116 per 1000 live births.

The infant mortality rate of Punjab (1959) is 97.12 per 1000 live births.

The still birth rate of Punjab (1958) is 9.35 per 1,000,000.

The maternal mortality rate of Punjab (1958) is 1.21 per 1000 live births.

The specific death rates of some of the most important causes of death in Punjab (1958) are :

Cholera	0.0005 per 1000.
Small pox	0.02 per 1000.
Fevers	9.94 per 1000.
Dysentery and diarrhoeas	0.45 per 1000.
Respiratory diseases	2.15 per 1000.
Injuries	0.19 per 1000.
Other causes	2.28 per 1000.

TABULATION

Human mind cannot easily grasp the significance of a large volume of statistical data. Classification of the information and setting out it in a tabular form provides one of the means of achieving this purpose. The process of tabulation consists in arranging in such a way that like is associated with like and facts which relate to different characteristics are arranged in mutually exclusive categories.

A good table throws into relief the important features of the data, economizes space and provides a convenient method by which various combinations may be easily read, compared and interpreted. A table must have a suitable title which should be clear and precise. Explanatory notes and definitions should accompany the table when ever necessary. Table must be numbered and also referred.

In a frequency table, all the observations are classified according to suitable class-intervals and the number of observations having values in each of the intervals is given against each interval (see table I).

Table 1 : Frequency distribution of the weights of a group of new born infants in Ferozepore (1958).

Class interval.	Frequency.	Class interval.	Frequency
Less than 1500 gms.	23	2400—2499 gms.	1483
1500—1599 ,,	117	2500—2599 ,,	1243
1600—1699 ,,	358	2600—2699 ,,	1137
1700—1799 ,,	432	2700—2799 ,,	839
1800—1899 ,,	651	2800—2899 ,,	743
1900—1999 ,,	783	2900—2999 ,,	542
2000—2099 ,,	820	3000—3099 ,,	231
2100—2199 ,,	1024	3100—3199 ,,	120
2200—2299 ,,	1256	3200—3299 ,,	58
2300—2399 ,,	1361		
		Total ...	13221

When observations are made on two attributes for each individual the data can be classified according to both the attributes simultaneously (see table 2) in order to depict the nature and degree of association between them.

Table 2 : Relationship between nature of food and Nutritional status in a group of students of Simla (1959).

	NUTRITIONAL STATUS.		
	Good	Bad	Total
Vegetarians.	53	78	131
Non-vegetarians	123	114	237
Total.	176	192	368

When observations on two measureable characteristics (continuous variables) are made on the same set of individuals, the data can be thrown out in a tabular form as in table 3, in order to know the nature and degree of the correlation existing between the characteristics.

Table 3 :—Bivariate frequency table showing the infant and maternal mortality rates, per 1000 live births for 48 different towns of the Punjab 1958.

Infant Mortality	Maternal Mortality Rates for 1000 live births						Total
Rates.	0.0-0.25	0.26-0.50	0.50-1.0	1.0-1.50	1.50-2.0	2.0-3.0	
50 to 75	3	2	1	—	—	—	= 6
76 to 85	4	9	5	1	1	—	=20
86 to 95	—	3	1	3	—	2	= 9
96 to 100	—	1	2	5	2	—	=10
100 to 105	—	—	—	—	—	1	= 1
105 to 100	—	—	1	—	—	—	= 1
110 to 120	—	—	—	1	—	—	= 1
Total	7	15	10	10	3	3	=48

From the design of the above table it is clear that if the two characters are positively correlated, then cells along the leading diagonal (upper left hand corner to lower right hand corner) will have more frequencies and if the correlation is negative the cells along the to her diagonal will have more frequencies.

Diagrammatic Representation :—The presentation of statistical material in grahic form is a device for emphasizing salient point which may be lost in the mass of figures in a table.

To quote the words of R. A. Fisher "Diagrams prove nothing but bring out standing features readily to the eye. They are therefore no substitute for such critical tests as may be applied to the data but are valuable in suggesting such tests, and in explaining the conclusions founded upon them." The most frequently used diagrams are of four types; those which are made for the purpose of comparison of things or events; those used to represent trends or changes with respect to time ; those used to distribution ; and those for facilitating computation.

In order to compare frequencies of things which very continuously we make use of histograms, frequency polygons, ogives etc. For things which very discontinuously we use bar diagrams and in order to depict percentage composition, we make use of pie-diagrams. In making a histogram we use the horizontal axis for representing class intervals and the vertical axis for the-frequencies so that frequencies are represented by rectangles of proportionate areas. By joining the mid points

of the tops of successive rectangles we obtain the frequency polygon. Ogive is the sort of curve which would be got if 1000 men taken at random were arranged in a row in order of their heights beginning with the shortest at one end and ending with tallest at the other and a smooth line touching the heads of each man be drawn. In bar-diagrams, bars of equal width with length proportional to the magnitude of the frequency of the groups represented are drawn without the sides of adjacent bars touching each other. In a pie diagram a circle is divided into different sectors, the angles of which are proportional to the percentages.

The commonest graph to depict the trend of events in time is a line diagram with time plotted on the horizontal axis and frequency or magnitude of the event in question on the vertical axis. In order to study the rate of change of any character, it will be more advantageous to use semi-logarithmic ruling in which the horizontal axis is ruled in the ordinary or arithmetic scale but the vertical axis is graduated according to the logarithmic scale. This kind of chart is called ratio chart and if points plotted on this chart fall nearly along a straight line it means that the statistical magnitude it represents is changing at a uniform rate.

In a spot map the locality of occurrence of an event is indicated by a properly located dot on the map. This kind of map is useful in epidemiological work. In shaded maps different types of shading or colouring of areas are used to bring out statistical facts.

In a nomogram complicated relationships among more than two variables are represented diagrammatically and complex equations are rendered easy for numerical solution.

AVERAGES

The most common measure of the average of series of measurements is the Arithmetic Mean which is obtained by adding all the observations and dividing the sum by the number of observations. An alternative measure known as the Median is got by arranging all observations in ascending or descending order of magnitude and picking out the middle. Another method of expressing an average is to pick out the observation or measurement which occurs most frequently and is known as Mode.

Consider the following distribution of the number of guinea pigs in 12 litters ; 1, 3, 2, 2, 5, 1, 2, 3, 3, 2, 4, 2. The arithmetic mean of the sizes of this group of 12 litters is got by adding all the litter sizes and dividing by 12 which is 30 divided by 12

or equal to 2.5 guinea pigs. If the litter sizes are arranged according to magnitude, we obtain the order 1, 1, 2, 2, 2, 2, 2, 3, 3, 3, 4, 5. Hence the middle, two observations are each equal to 2. Hence, the median size of litter is qual to two guinea pigs. The mode of the distribution is also equal to 2 because it has the maximum frequency, viz. 5.

The median possesses some advantages over the arithmetic mean. If it is desired to get the median height of a group of children they may be lined up in order of height and the middle child picked out without taking the actual measurements of all the other children. Another advantage is that it is not affected by the extreme members of the group, as in the case of the arithmetic mean. Consider, for exemple, the deaths from cholera in a town for eleven years-8, 3, 10, 11, 14, 14, 432, 2, 6, 5, 0. The arithmetic mean of these 11 observations is 45 deaths which hardly gives the normal experience of the town. But the median figure of 6 deaths is a better index of the normal experi ence of cholera deaths because it is not so much affected by the extreme figure of 432 deaths of an epidemic year. When a distribution is very unsymmetrical and number of obserations is large, the mode gives a very satisfactory measure of the average.

Consider two sets of values giving the weights in lbs. of two groups of boys viz. 36, 40, 28, 56, 81, 120 and 17 and 52, 54, 58, 51, 50, 55 and 56. Both these two groups have the same arithmetic mean value of 54 lbs. But it is clear that the two sets of observations have wide differences with regard to the variation of the observations among themselves.

There are various measures to describe the variation of a set of measurements. The simplest is the Rangs which is the difference between the largest observation and the smallest observation. An improvement on Range is the Interquartile Range which is the difference between the upper quartile and the lower quartile. The upper quartile is the value which have three fourths of the observations below it and one fourth above and the lower quartile has one fourth of the observations below it and three fourths above it.

The standard measure of variations is known as Standard Deviation. It is obtained as follows : the difference of each observation from the arithmetic mean is obtained; the differences are squared and added, the sum is divided by the number of observations; the square root of this quotient is the standard deviation.

The unit of study of public health workers is the community as a whole. We are interested in the whole population as a group, and not in the individuals in their individual capacity.

As such, we have to study the characteristics of the community in order to define our problems and to assess our results. It is not always practicable to meet every individual in the community for the purpose. Even if it were possible to do, it is not worth the effort and expenditure involved. We may study a part of the community, and if the selection of the part has been properly done, we may, with a reasonable degree of correctness, assume that our results are applicable to the whole of the community. This process of the selection of a part to represent the whole is called sampling. The part so selected is known as a "SAMPLE".

Sampling process consists in the selection of a part of an aggregate (called population or universe to represent the whole or aggregate. Sampling examples are provided by a handful of grain taken from a sack or a piece of cloth cut off a roll. A sample is a part of population and a sample is said to be a random one, if every individual in the population has an equal probability of being included in the sample.

The object of sampling is to obtain the nearest estimate to the values in the population for the labour expended. In other words, the purpose of sampling procedure is to secure a sample which subject to limitations of size will reproduce the characteristics of the population, especially of immediate interest, as closely as possible.

CHAPTER XXII

MENTAL HYGIENE

(By Dr. Vidya Sagar Medical Supdt. Pb. Mental Hospital Asr.)

Mental Hygiene comprises the activities and techniques which promote and maintain mental health, which is the capacity in an individual to form harmonious relations with others and to participate in, or to contribute constructively to changes in his social and physical environment. It implies also an ability to achieve a harmonious and balanced satisfaction on his potentially conflicting instinctive drives and a personality which have developed in a way which enables these drives to find harmonious expression in the full realization of his potentialities. Mental Health is influenced by both biological and social factors. It is not a static condition but is subject to variations and fluctuations of degree.
It may be studied under the following heads:—

1. Mental disorders.
2. Prevention of mental disorders.
3. Prevention of mental health. (*a*) Personal and (*b*) Public.
4. Administrative aspects of mental health services.

I. TYPES OF MENTAL DISORDERS

(*a*) **Organic Nervous diseases** *i.e.* those following upon infectious, toxic, degenerative, traumatic, vascular, nutritional, metabolic and endorcrine disorders, and inflammations, new growths, cysts etc. of brain.

(*b*) **Functional nervous disorders or emotional disorders :—**

(*i*) Psychosis or insanities :—Schizophrenia, manic depressive psychosis, involutional depression and paranoia.

(*ii*) Neurosis or Psychoneurosis :—Hysteria, anxiety neurosis and obsessive compulsive neurosis including phobias.

(*c*) **Psychosomatic disorders,** such as cases of hypertension, gastric ulcer, headaches, diabetes, eczemas, urticarias, allergic conditions, progenital disorders, (frequency of micturition, impotence, frigidity etc.)

(*d*) **Mental Deficiencies** (Amentias), which include cases of "any kind of degree of arrested or incomplete development of the mind existing before the age of 18 years, sufficient to prevent the individual from making

an independent adaptation of life and to render him in need of external care." They are classified into 3 grades:—

(*i*) Idiots :—Who are unable to guard themselves against ordinary physical dangers.

(*ii*) Imbeciles :—They are able to do simple routine jobs but unable to lead independent existence.

(*iii*) Feeble-minded :—They can only do simple routine jobs independently but cannot benefit from education in ordinary schools.

(*e*) **Psychopathic personalities** :—They are emotionally unstable and impulsively aggressive from an early age, and give evidence of being unable to learn from experience and have no consideration for others.

(*f*) **Cerebral dysrhythmias** (idiopathic and secondary):—shown as various forms of epilepsies and epileptic insanities.

(*g*) **Behaviour disorders** of children such as truancy from school, rebelliousness and juvenile delinquency.

Causation of mental illness :—Three factors, namely constitutional, psysical and phychological are attributable as causes of mental diseases. The trinity is closely inter-woven in the production of a given psychiatric state, though the part of each varies in each individual, but it cannot be objectively clearly separated.

The constitution of an individual is based on heredity and gets modified by the environmental factors of nourishment intra-uterine life (influenced possibly by the emotional state of the mother) and by the social, climate, dietetic and other environmental factors of extra-uterine life.

The constitutional peculiarities (which, however, be accurately measured or predicted) are responsible for the predisposition to mental illness while physical and psychological factors constitute the precipitating causes.

Physical factors have been briefly referred to against organic mental illness (vide supra), but they will not account for the individual or personal differences in the mental symptoms, which are determined by the individual's psychological biography.

Psychological factors :—Psycho-analysis has revealed three strata of mind : (i) the central core, the *id* or the biological mind, common to all living beings, manifested in the need for physical and emotional security : (ii) the *ego* or the intellectual understanding of self and the environment: and one's own formulation of ambitions, standards and ideals called the egoistic drives and (iii) the *super-ego* or conscience, which enshrines the do's

and dont's of society conveyed very early in life through parents and subsequently through teachers, books and other sources of information. Conflicts between id and ego, or between either of these and the super-ego, which occur at every step of our lives, produce a painful emotional state of nervious mental tension, which gets modified by certain inherent unconscious mental mechanisms called defence reactions of ego, with the result that it either gets eased off, or failing that, it provokes certain secondary effects in the mind (and through nervous pathways' in the body), leading to a variable degree of physical ill-health, and disturbance of intellectual efficiency, emotional balance and of harmonious relations with others.

II. PREVENTION OF MENTAL DISORDERS

Unlike many preventable physical diseases, described in other parts of this book, nearly 70% of mental illnesses in Europe and over 90% in the Punjab (according to my own experience of outpatients and inpatients at the Punjab Mental Hospital, Amritsar), have no specific physical or psychological aetiological factors for their causation and epidemiology, (conditions that determine the frequencies of the diseases) with the result that distinct techniques of immediate prevention of functional mental illness are not available. An emotional disorder depends partly on constitution and partly on environmental influences, particularly of the early age-period. So far as the latter are concerned, the real prevention would come from a whole-life policy, beginning from infancy.

III. PROMOTION OF MENTAL HEALTH

(a) **Personal** :—Personal mental hygiene deals with matters pertaining to the mental health of the individuals and their children, for whose proper bringing up they are responsible. The principles which should guide us in teaching the subject to people are given below :—

For Adolescents and Adults :—*1. Love Thyself* :—'Love Thyself means, that one should feel happy as one is, feeling grateful to nature for not having been made worse, nor envying better people, since no two things are alike in nature. Diminution of the fund of self-love leads to feelings of inferiority which are the bane of a young person's life, as they lead to nervousness, lack of self-confidence and drooping of spirits.

2. Adaptation (Harmony) with environment and with one-self :— Adaptation with self, refers to easing off of intrapsychic conflicts relating to sex and rigid egoistic standards, as they are not easily resolved and precipitate mental illness. Harmony with environment means harmonious social relations which give us the very much needed emotional security.

3. *Concede freedom of thought and action to others within the framework of harmonious social relationship* :—This principle is the instrument for achievement of social harmony, and inculcates in us, respect for the feelings and rights of others.

4. *Active interest in games and in physical exercise* :—Its advantages are :—(*a*) Maintenance of bodily heat and tone of voluntary and involuntary muscles.

(*b*) Easing of nervous tension, as per the dictum of Sherrington, one of the greatest neurophysiologists of the present times, *viz.*, "Nervous tension is eased most by muscular exercise, least by thought and by speech in between."

(*c*) The struggle for existence is waged with brawn, under the guidance of brain.

(*d*) Teaches team-spirit and healthy competition.

(*e*) Inculcates the habit of vigorous work and fair-play.

(*f*) Friendly competition and even chances of victory and defeat mellow down our emotional reactions to successes and failures in life.

(*g*) It gives us the joy of achievement and enhances self-confidence.

(*h*) Physical stamina cultivated in games enables us to pursue mental work with vigour.

5. *Acceptance of want, hardship and pain as essential stimuli of life* :—Mighty forces of nature can do a lot of harm to man and he is bound to force want, hardship and pain not infrequently. Man must accept these as essential elements of life and stimuli to vigorous action. Without obstacles, life would be insipid and, therefore, we must meet them courageously, accepting what we cannot change. Religion, which is essentially faith in the presence of Fatherly Almighty God is but a simpler form of visualizing the mighty forces of nature mentioned above. As this is the accepted sentiment of all mankind, it can be made use of, for personal mental health and universal peace.

6. *Subordinate emotions to intelligence, enriched by active association with others* :—In our daily life we do not foster deeper insight into our actions, with the result that, in many of our activities, we are more emotional than rational. With our limitations as human beings, we are bound to make mistakes in life but a certain degree of introspection is essential, to understand our actions and to plan their betterment in future situations. We have to understand that with our limitations as human beings, we are bound to make mistakes, as in the time-honoured adage. "To err, is human", and that we have to learn from our mistakes and not to brood or weep over them. All types of experience adds to our learning.

From the point of view of evolutional history, anxiety which is based on memory and imagination, is an advance over fear, as it enables us to anticipate danger, pain, injury, sadness and other uncomfortable events, far ahead of the actual happenings. The response to anxiety should be planning to get over the expected difficulty, rather than rumination which would result in exaggerated or morbid anxiety.

Active association with others enables better information and consequent wider perspective. Such persons are more likely to keep in step with reality and their chances of harbouring phantasies, day-dreams and speculative suspicions, as occur in schizophrenia, would be eliminated.

7. *Be informed on sex* :—Almost the entire human culture over the ages has clamped a taboo on sex, and the religion that allows initiation of conjugal relationship with so much fan-fare, pomp and show, decries sexual pleasure vehemently. Most youngmen in India (as assessed from my contacts with Punjab students and others) trudge through their adolescence under a heavy load of sex fears, relieved only when they find themselves to be potent sexually after marriage, and on learning of pregnancy in their wives.

It is nothing but a myth to believe that erotic fentasies in a young person are indicative of mental derangement or that they are sinful. Youngmen should be given correct information about the physiology of seminal fluid and technique of coitus and of the effects of " night discharges" and of masturbation to disabuse their minds of supposed serious consequences of imagined sexual and other diseases resulting from them.

Rules of mental hygiene for infants and children :—These rules are similar to those described above and do not need very detailed explanation. 1. *Accept the child and love him* :—The thought of a child being not needed or not desired (because it has not the desired gender or is an unwanted addition to the already large family or is disabled physically or mentally), may make us utter unsavoury words or be harsh to the child. Loving the child means feeling happy with him without any reservation. The child being an absolutely dependent organism needs abundant love for his healthy emotional development. Children suckled by unhappy mothers often suffer from indigestion, disturbed sleep and frequent crying, while a loved child, personally attended to by its mother does not develop those and undesirable habits, such as, thumb-sucking, shyness and faddiness for food. Likewise, the older child is saved from such bad habits as stealing, sexual perversions and rebellious conduct.

2 *Respect the child as a person* :—Respect consists in appreciation of certain qualities in another individual. The child needs

to be appreciated foı its natural efforts for self-development by its innocent inquisitiveness, motor activity and for its profound attachment to the parents. Our failure to do so hampers the child's balanced emotional development and may produce feelings of inferiority in him.

3. *Do not dissuade a child from misconduct by a show of temper nor frown at his mistakes* :—The child develops the same emotional pattern, as the people with whom he is closely associated. A rigid and guilt-laden attitude towards a child's errors would be followed by the development of a rigid, obsessional character, in which a person is never happy with himself, It is a mistake to think, that strict and harsh vigilance of the child against making mistakes or doing bad acts, would develop into a lofty character. Such a child develops a mixed attitude of love and hatred for the parents and those in authority and is apt to get badly shaken with self-hatred on having done a mistake. The children of carping, nagging parents, either become rebellious or timid or get short of initiative and self-confidence.

4. *Do not expect from the child a standard of behaviour higher than that reasonable for his age* :—This kind of approach would lead parents to with-hold their full acceptance and love for the child; and when it leads to expression of disappointment with the child, it produces in him feelings of anxiety, inferiority, depression, sulkiness and at times disgust.

5. *Answer a child's question intelligently, giving short concrete answer within his intelligence* :—A human child is naturally inquisitive and parents must answer its questions precisely. Further, we should encourage motor self expression, by letting him do things, as he likes, guiding him, here and there. Curbing this inquisitiveness would lessen his initiative, self-confidence and interest in outside things and may make him introvert.

6. *Let there be the same code of conduct for the young and the old* :—A child gets perplexed when he is asked not to do a thing which the grown-ups are doing. I have known a child of three, questioning his parents for doing the same action, which he had not been allowed to do.

7. *Never threaten or promise anything that you cannot or do not intend to carry out* :—A threat is a fear of possible harm from a certain action. It should be gently told to the child but without exaggeration, lest it should generate severe anxiety in him. Threats of a policeman, ghosts or devils which are far from reality, create misunderstandings about a highly valued servant of society and the fear of the unknown, respectively. When father is held out as a punishing person the child develops fear of authority and if deprived of a good deal of

emotional security in life. The threat of punishment should be gently given, without being influenced by anger and vindictiveness. The child should never be put to shame in presence of his brothers, sisters or friends. Punishment can be graded; first, withdrawal of certain privileges in the family such as going out for shopping or attending an entertainment, then with-holding pocket-money or sweets and finally a slap or two. Parents will be considered as untruthful or undependable if promises made by them to children are not kept. Repetition of such experience will distort a child's view of the world of grown-ups.

8. *Inculcate soical interests* :—From the young age of 6-9 months, the child should be given opportunities of associating with its peers, sharing sweets, toys and the love of mother with them. By personal example, parents give practical elementary lessons in self-denial and social service and prevent the canker of jealousy taking root in the young child.

9. *Encourage self-expression* :—The child expresses itself first through movements and later through speech. Giving of maximum freedom of movements and speech, imperceptibly guided into purposive channels of play, conversation and answers to their questions, is the best training in self expression, which enables the child to achieve maximum realisation of its potentialities. This guidance by parents, in the role of friends and mentors, must continue when the child starts attending school.

10. *Bringing up of the child is your personal responsibility* :—Reproduction, a creative activity, does not end with the birth of the offspring, but needs to be continued with unflagging interest and enthusiasm till the child grows to lead an independent existence. Parents should consider the children to be a part of themselves because through them they hope to achieve some of their unfulfilled wishes. They must give personal attention to the child's bringing-up, as they do to their other personal affairs. Care by a nurse, maid or a governess is, no way, equivalent to or substitute for parental warmth and understanding. Personal responsibility should not transcend into deep attachment which makes separation unbearable. It is, therefore, evident that the child be not considered as a possession, but a trust to be allowed to grow and blossom.

III. (b) Public health programme :—The following extracts from the World Health Organisation Technical Report No. 31, gives an admirable introduction to the description of activities and techniques which promote and maintain mental health of the community.

"Until a great body of technical knowledge suitable to the training and capacities of the workers concerned has been deve-

loped, the mental hygiene contribution which the public health worker can make in his day to day work may be broadly described as the appreciation of human problems in a human way, an appreciation for which existing system of medical education do not usually provide sufficient preparation."

"Even when there is no formal programme for mental hygiene, it is implicit in a very wide range of public health activities. It is always implicit at those times, when in the course of his duties, a health worker has a personal relationship with a patient or another member of the staff. In interviews and in giving council, the mental hygiene influence of the health worker is direct in reducing anxiety, giving reassurance and in providing the conditions through which the individual can find for himself the solution of his emotional and social problems."

"To summarise, the essentials for an effective mental health programme are :—(a) The worker should manifest in his own talk general behaviour, the principles of mental hygiene. (b) He should study and evaluate the prevailing attitudes and practices of the community and then adopt his teachings for producing a gradual change in them.

Mental hygiene programme in maternity service :—The maternity services provided in the ante-natal clinics and through the home visits of the lady health-visitors, have hitherto been in terms of general hygiene nutrition, medical care and pelvic measurements. However, it needs to be realised that pregnancy is a great emotional experience. "The attitude towards the prospective child (wanted or unwanted), the minor and major discomforts and hazards of pregnancy and parturition, the satisfaction of fulfilment of her biological role as a woman, and of added prestige in the family, the anticipation of a change in respect to her, daily routine and in relation to her husband and to others who come into close personal contact with her and the facts of her personal information on the subject, economic factors and cultural patterns will determine, if this experience would be a rich and happy one or one full of anxiety, misgiving and fears."

The responsibility of doctor or nurse towards the pregnant mothers is, as below :—1. Imparting of information about gestation and labour, at a very slow pace, in the discussion group meetings in the antenatal clinic. This will also dispel anxieties which arise from ignorance or mis-information.

2. To encourage the prospective mother and father to speak out their anxieties and fears born or traditional beliefs, and to listen to them with understanding and tolerance, with a view to help them to work out the solution of their emotional problems.

Mental health of infant and preschool child :—The following practices in the handling of infants are to be guarded against because these damage the developing personality by generating inordinate anxiety at this tender age :—

1. Bottle feeding.
2. Rigid feeding and sleeping schedules.
3. Impersonal handling of the body.
4. Intolerant and premature toilet training.
5. Restriction of infantile movements.
6. Breast feeding must not be continued after the age of one year, and weaning must be gradual and not sudden.
7. Infants and children must never sleep on the same cot as their mothers, sisters or grannies.
8. Giving extra attention and indulgence to one child, as compared to the others, particularly the one immediately next to him.
9. The child should be encouraged to take active interest in play and express himself freely in speech. It must never be ordered about too much, nor brought up in relatively rigid discipline and code of morality, as it would not allow taking a lenient view of its mistakes and shortcomings, in later life.
10. Children between the ages of 6 months to 30 months, must never be separated from their mothers, as it leads to emotional depression, in which the child becomes quiet, withdrawn and rather dull. There is evidence, that children separated at this age-period from loving mothers develop into antisocial, psychopathic personalities, unless they develop bonds of warm affection with foster mothers.

Mental health of school going child :—Next to home, the school is the place where the child spends most of his time and it should, therefore, be like a home, where principles of mental health discussed in the preceding sections are translated into practice by the teachers ; who are parent-substitutes there. The object of teachers should not merely be imparting instructions in arts and science for gaining certain vocational skills, but to promote fuller development of the potentialities of the child as well, for a well-adjusted and happier life, which can only be done in an atmosphere of pleasant social relationship of the pupils with the teachers and amongst the pupils themselves. The behaviour of the teacher towards the school children and his methods of teaching would not only modify the personality of the child, but also influence him (the child) immensely in

forming a personal ideology or a style of life. Teaching through play, for the kindergarten and primary school and through manual work in the middle school allows the children to develop keen interest in education and make full use of their innate endowment.

Sex information :—The science of mental diseases teaches that a large proportion of emotional disorders are caused by fears and guilt associated with sex ideas, interests and functions. From the point of view, of mental hygiene, it is, therefore important that information on sex be introduced in the school curriculum as a nature-study subject beginning with study of common plants, flowers and birds, formation of fruits, reproduction in common insects, pets and domestic animals, and finally in the high classses, general physiology of human-being including reproduction. The information, thus gained, will be shorn of guilt, shame and curiosity associated with sex to an intense degree in the adolescent and adult mind, and to a milder degree in the average married man and woman, at present time.

Backward children in schools : – Grossly backward children need to be given education in special schools, where emphasis is laid more on manual work than on formal education. Such children, apart from being a drag on other students of the class, will very likely, develop strong inferiority feelings, even if they are not chided by the teachers or tested by their classfellows. Separating the mentally backward children from the average is therefore, an important part of Mental Hygiene programme otherwise such children either become problem children or get emotionally disturbed.

Delinquency in children :—Anti-social conduct in children is due to the following causes :—1. Improper home environments, due to unstable, alcoholic or mentally deficient parents.

2. Want of playing fields, where the childern give expression to their innate psychic energy of aggression and learn ways of fair play

3. Harsh treatment meted out at school for poor school-work.

4. Falling into the company of gangs of antisocial adolescents, which is more likely to occur, when there is no happiness in the home.

5. Influence of bad cinema pictures.

Avoidance of these causative factors, and concentration on healthy development of the personality of the child, as explained earlier, would constitute remedies for stamping out of delinquency.

Mental health problems of adolescents (14 to 20 years old youths) :—Adolescence is a period of change in the sphere of physical, mental and social development of the child, and is, therefore, exposed to stresses, some of which are listed below :—

1. The growing child, who has been progressively learning more and more, feels greater confidence in his own abilities with consequent craving for more independence, which may be resisted to varying degrees, by parents, with consequent sulkiness, nagativism, and major or minor defiance. The adolescent finds fault with the ideology and conduct of the parents and doubts their ability to guide him.

2. The onset of puberty with the appearance of menstruation in girls and of night emission in boys, brings about a varying degree of fear in their minds as they are ignorant of them.

3. Awakening of sexual interests, ideas, activity and phantasy is usually associated with guilt feelings, because of the strict social and religious taboo, on sex. For the same reasons, the biological interest in numbers of the opposite sex weighs equally heavily on their minds.

4. The ability to earn money after leaving school is likely to inflate their immature ego and add to conflicts with parents and with authority.

The adolescent needs to be given guidance in these difficulties through information on sex, ethics and social relationships, in school and through other channels of information detailed subsequently.

IV. ADMINISTRATIVE ASPECT OF MENTAL HEALTH SERVICES

The spirit of work in all human endeavours, more so in Mental Health services, should be the cultivation of good interpersonal relations amongst fellow workers or fellow members of the staff of the organisation, which is bound to be reflected in their tolerance and understanding of those whom they serve.

The treatment using of the Mental Health Services is as important as the preventive side and should be adequately provided for, as in general medicine. It needs to have the following separate departments:—1. Mental Hospital accommodation for the treatment of fresh cases, at the rate of at least one bed per 2,000 of the population, located in small units of hundred beds in different parts of the State. Admission to these hospitals should be open as in a general hospital, unlike the present system of getting order of admission from the District Magistrate.

2. Homes for incurable insanes, advanced mental deficient patients and for advanced epileptics, having bed accommodation at the rate of one bed for 500 of the population. Admission to

these institutions and decision about the liability for maintenance charges would have to be made by the law-courts as in these days.

3. Out patient psychiatric clinics, associated with all Mental Hospitals and with the District Head-quarters General Hospitals.

4. Child Guidance clinics at every District Head-quarters for the early treatment of behaviour-disorders of children.

5. Hostels for delinquent children, separately for different age groups, associated with a regular clinic for the treatment of delinquency.

6. Special schools for back-ward children.

The Mental Hygiene wing of the Mental Health Services has to be very broad based, as is evident from the preceding pages. It may be summarised as follows :—1. Lady Health Visitors, Midwives, Nurses and doctors of the ante-natal clinic, give mental health guidance to pregnant and recently delivered women.

2. The lady health visitor, the school teacher, the school medical officer and the general practitioner, direct behaviour-problem-children to the child-guidance clinic.

3. The school psychologist studies problems of backwardness in studies and behaviour problems, in which he gives preliminary guidance, and refers the unimproved cases to the child-guidance clinics. He also gives vocational guidance to the scholars.

4. The school teacher who has a very great influence in the building up of the personality of the child needs to be psychologically orientated, so that his teaching and, general behaviour is guided by psychological principles.

5. Youth guidance clinics for the adolescents.

6. Marriage Counselling Bureaus, staffed by psychologists and social workers, for the guidance of married people.

7. Psychiatrically-orientated medical practitioner, has a very vital role to play in the Mental Health Services, by early diagnosis of illness and aberrations in behaviour, caused by psychological factors, and by proper handling of the physically ill and the convalescent patients, to prevent over-lay of psychogenic illness.

8. Social clubs :—The psychiatrist and other staff of the psychiatric outpatient clinic, in association with local teachers, professors and the gentry can start separate social clubs for youngmen and young-women, preferably in school and college buildings where apart from playing, games, debates, discussions and lectures can be arranged for the benefit of the young people. Parents can be invited to these clubs and discussions

held with them on the problems of young children and adolescents.

9. The public health service staff, who come into close contact with the public, have an important role to play in propagation of mental health and they need to be as well trained in it, as school teachers and ancillary medical staff.

10. Health Education of the public through newspapers, radios and the cinema screens.

The senior officers of the Mental Health Service, who have built a good name and reputation can contact the newspaper editors in their area and arrange to publish simple informative articles on the bringing-up of children and management of the behaviour problems, on the prevention and treatment of mental illnesses and other allied subjects. They might answer some of the enquiries of the readers of the paper, in its columns. Like wise they may arrange talks on the radio on the common mental health problems and connected subjects. In this way, they shall have made the public mental hygiene conscious. Subsequently, the cinema story-writers would certainly take up the mental health problem-theme for their pictures.

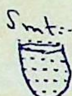
Films and film-strips on mental hygiene subjects, prepared in certain advanced countries, can be obtained through the courtesy of their Embassies, for exhibiting to selected audiences.

Books and periodicals on Mental Hygiene, suitable for lay readers, can be got introduced in schools, colleges and public libraries and information about the same got published in magazines and newspapers.

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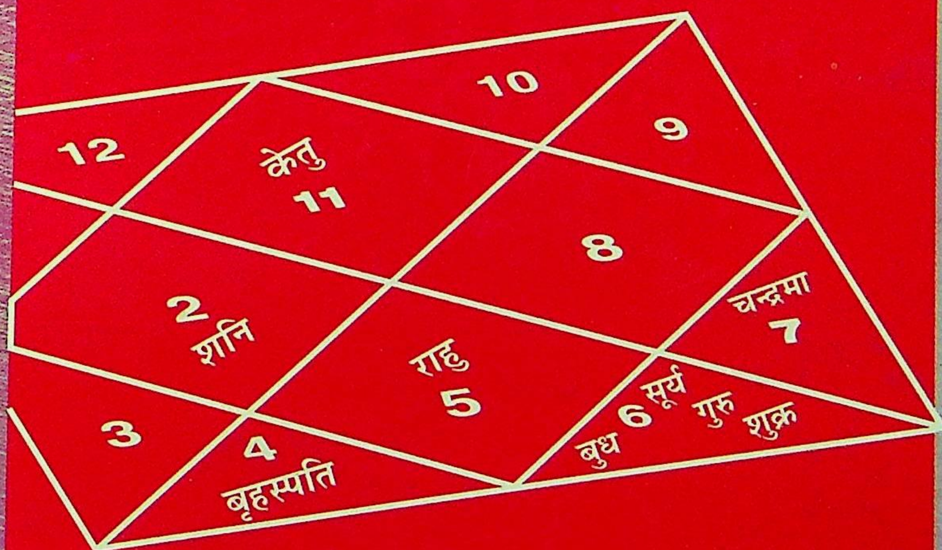
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श्रीनिवास महादेवपाठक विरचितं

दशाफल दर्पण

व्याख्याकारः
डॉ. सुरेश चन्द्र मिश्र, ज्योतिषाचार्य
एम.ए.पी.एच.डी.



विंशोत्तरी दशा पर एकमात्र प्रामाणिक, प्राचीन एवं प्रसिद्ध ग्रन्थ, सर्वप्रथम हिन्दी भाषा सहित